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WINDS, CURRENTS, AND NAVIGATION

OF THE

GULF OF CADIZ,

THE

WESTERN COAST OF THE SPANISH PENINSULA,

AND THE

STRAIT OF GIBRALTAR,

COMPILED FROM THE MOST RELIABLE AUTHORITIES,

BY

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WASHINGTON.
GOVERNMENT PRINTING OFFICE.
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of Washington.

PREFACE.

There are few parts of the ocean more traversed than the Strait of Gibraltar and the adjacent sea, and the navigation of the one is necessarily connected with that of the other, both on entering and leaving the Mediterranean Sea. In this work we have attempted to give, from the most reliable sources, the winds, currents, &c., generally encountered in the Gulf of Cadiz, on the western shore of the Spanish Peninsula, and in the Strait of Gibraltar, with the navigation of these localities.

The greater portion of the remarks on the Gulf of Cadiz and the western shore of the Spanish Peninsula are taken from a paper by Señor Don P. Riudavets y Tudure, chief of the Royal Hydrographic Office at Madrid, published in the *Anuario Hidrografico* of 1867; those on the Straits of Gibraltar are from the *Manuel de la Navigation dans le Détroit de Gibraltar*, by C. A. Vincendon-Dumolin, ingénieur hydrographe, officer de la Légion d'Honneur, &c., and Captain C. Philippe De Kerhallet, of the imperial French navy, commandeur de la Légion d'Honneur, &c.

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NOTE.

We give to the winds the name of the point of the compass from which they blow; to the currents, that of the point of the compass toward which they run.

The courses and bearings are corrected for the variation of the magnetic needle, except when otherwise stated.

THE WINDS, CURRENTS, AND NAVIGATION

OF THE

GULF OF CADIZ, THE WESTERN SHORE OF THE SPANISH PENINSULA, AND THE STRAIT OF GIBRALTAR.

CHAPTER I.

WINDS.

As the part of the Iberian Peninsula under consideration varies much in contour, one line of its coast being nearly at right angles to another, and as this difference of direction produces an effect on the winds and currents that prevail in the neighboring seas, we will first describe their prevailing characters between the Strait of Gibraltar and Cape Vincent, and then those between this cape and Cape Prior.

Gulf of Cadiz.

The portion of coast included under this name is the great bay which the south coast of Portugal and the sea-coast of Spain form with the coast of Morocco. The limits of this gulf, which might be permanently named the Gulf of Cadiz, are the Cape St. Vincent to the north, and that of Mazagan to the south, those capes lying north-north-west and south-south-east of each other, two hundred and thirty miles distant. This great gulf, which, as we have observed, is entirely open to winds from W. to S., would be no doubt very dangerous to vessels if it had not at its interior the Strait of Gibraltar, and a little to the northward of it the excellent shelter of the Bay of Cadiz.

Winds, Gulf of Cadiz.

It is admitted that winds are merely currents of our atmosphere, occasioned by diversity of temperature, and that such currents are affected by the configurations of continents over which they pass, the presence of seas near them, lakes, river overflows, &c.

We also know that while, in a certain extent of sea, a certain wind prevails, in another not far from it another wind is blowing, if not directly opposed to it, at least from a very different quarter. Thus we find that in the limited space of the ocean under consideration, off the western part

of the peninsula, fresh northerly winds may prevail; while in the southern portion of it S. E. winds are blowing of more or less duration. This contrast of direction is very remarkable, and owes its origin not only to the configuration of the coast, but also to the proximity of the Mediterranean.

Within the Gulf of Cadiz, and especially near the Strait of Gibraltar, easterly and westerly winds are the most prevalent, while on the coast of Portugal and Galicia, northerly and southerly winds are the most common. By the term *easterly*, is meant the winds which blow from E. N. E. to E. S. E.; and by the name of *westerly*, those which blow from the opposite points, or from W. N. W. to W. S. W.

The observations in the following table were made at the Tower of Tavira, in Portugal, on the northern boundary of the Gulf of Cadiz:

Class of wind.	Number of days of each wind.					Total days of each wind.
	1856.	1857.	1858.	1859.	1860.	
Calms	0	1	2	1	1	5
Light variable	19	16	4	28	20	87
N	2	6	13	5	8	34
N. N. E	14	11	11	13	12	61
N. E	14	16	15	22	12	79
E. N. E	4	9	10	9	2	34
E	76	72	50	46	53	297
E. S. E	6	11	17	3	5	42
S. E	12	13	9	16	16	66
S. S. E	3	3	5	2	.....	13
S	14	16	18	6	9	63
S. S. W	12	14	6	6	6	44
S. W	28	27	35	27	30	147
W. S. W	35	29	38	46	40	186
W	27	31	22	27	26	133
W. N. W	26	27	18	23	40	134
N. W	70	55	84	79	81	369
N. N. W	4	8	8	6	5	31

RESULTS.

Number of days N	34	Number of days of 1st quarter	471
Number of days S	63	Number of days of 2d quarter	184
Number of days E	297	Number of days of 3d quarter	512
Number of days W	133	Number of days of 4th quarter	568

Days of E. wind during the five years 373
Days of W. wind during the five years 455

It will be seen from the above table that westerly winds, or those between W. N. W. and W. S. W., much exceed those

from the eastward, or between E. N. E. and E. S. E., although the days of easterly wind surpass considerably those of westerly wind. This must be attributed to the fact that the winds from the third quarter (or S. W.) are always more lasting than those of the second, (S. E.,) as those of the fourth (N. W.) are more so than those of the first, (N. E.) Consequently, the W., which participate with S. W. and N. W., have a great predominance over the easterly winds, which participate with opposite points N. E. and S. E.

N. W. winds.

The winds which also prevail much at Cadiz and its vicinity are those of the fourth quarter; and of these, those from N. W. predominate, which circumstance arises, probably, from that bay being situated at the eastern limit of the Gulf of Huelva, into which the Rivers Guadalquivir, Guadiana, Odiel, and Tinto empty.

S. W. winds.

Next to winds of the fourth quarter, those of the third may be considered to predominate, which are those that bring the storms and rains of winter, and are the same that in summer constitute the *virazon.*

Northers.

Northerly winds blow but little, and when they do, generally in winter. They must be considered as land winds, and always incline to the N. E. in the Mediterranean if the easterly winds prevail, or to the N. W. if in the ocean with a westerly wind. The winds of the first quarter (between north and east) are the least violent, and mostly attended with clear weather.

Southerly winds.

Southerly winds do not blow much, for, in winter time, they soon haul to S. W.; and in summer they form part of the virazon, and are transitory.

Although the *levanters* prevail at all times of the year, they do so more in the months of March and April and in the hot months. In July, 1856, there was a whole fortnight of continuous easterly winds, as also in August of that year.

The N. E. winds, as we have seen, were the most persisting, and prevailed from March to September, blowing hardest in April and May.

From November to March, or in the winter months, the S. W. winds were the most prevalent; and they certainly are the winds most to be feared in the Gulf of Cadiz; for, besides blowing strong, they bring heavy and constant showers, which conceal the land, and throw in so much sea that all the bars become impassable. These winds, called *vendavales*, vary between W. S. W and S. S. W. Fortun-

ately they give notice of their approach, and the navigator who may either be cruising off Cadiz or to the westward, sees its approaching signs, and can get clear of the shore to the parallel of the strait, and if necessary he can always be sure of the strait.

Signs of the vendaval.

The vendaval gives unequivocal signs of its approach. If the easterly wind be blowing, it will veer to the S. E., the sky will become obscured and the coast concealed, especially the Broa of San Lucar, the wind may be expected from the southward with rain, and soon the vendaval will follow. This change is always preceded by a considerable fall of the barometer.

A calm and a dense fog are always signs of the vendaval. In winter, after the levanter has been blowing, if it draws from S. E. to S., and continues so with light misty winds, a gale may be expected from the offing. Vessels should be careful not to encounter the vendaval, not only on the dangerous coast between Point San Sebastian and Cape Trafalgar, but also within the Gulf of Huelva. On the first, beset with reefs, the sea breaks at a great distance from the shore, and it often happens that breakers are seen before the coast is visible. On the second portion of the coast a vessel runs great risks from the breaking sea which is raised by the gale, in addition to which there is a set toward the shore; and if the navigator should not have sufficiently foreseen this, so as to provide against it, and becomes hampered, he may reckon himself fortunate if he is not wrecked on the Arenas Gordas. On that portion of coast between Cape St. Mary and Cape St. Vincent the risks are not so great; for, with the wind at S. W., a vessel can escape by standing off southeast, unless the wind be so strong that with it and the sea she cannot weather Cape St. Mary.

In respect of the coast of Africa included between Cape Mazagan and the strait, there is not so much risk with the vendaval, because the land trends much in its direction, and has no great sinuosity. The worst winds on this coast are from W. to N. W., and with these a vessel should take care not to risk her safety in Jeremias Bay. What is most to be apprehended in this part is the sea which always gets up; this, in a gale on shore, will very soon lose a ship and her crew, should she unfortunately, in the thick weather of the vendaval, mistake this bay for the entrance of the strait—a mistake, indeed, which has been fatal to many vessels.

Veering of the vendaval.

Although usually the vendaval does not last above three days, sometimes it is stubborn and will continue for nine, or even twelve, days, with but slight interruptions. If, after blowing strong, it veers to W., fine weather may be looked for, because it does not remain long at this point, but hauls to N. W., which is generally the concluding quarter of the gales in our hemisphere, and is that which clears up the atmosphere. But if from W. it returns again to S. W. the bad weather will begin afresh, and the wind will blow harder than before, although it may not last so long. But when it becomes steady at N. W. it very seldom backs to S. W.

The wind once established at N. W., for some days it may blow hard, but then will become more moderate, and is almost always attended with clear weather, although blowing harder by day than by night. If it change to N. afterwards, it seldom remains so long; it will pass to N. N. E. and then to N. E., where it will remain for some days more. This wind is always the precursor of the levanter, N. E. and easterly winds in the Gulf of Huelva. In winter time in the Gulf of Huelva, N. E. winds are the almost certain sign of the levanter blowing at Cadiz and in the Strait of Gibraltar, as the N. W. winds are of there being a westerly wind on the south coast of Portugal. In the Gulf of Huelva the levanters are not so fresh nor yet so lasting; they sometimes take two or three days to reach Huelva, and die away there before they cease at Cadiz.

The levanter.

The greatest scourge of the Bay of Cadiz is undoubtedly the levanter, or E. wind. When this wind has continued for a week, perhaps for a fortnight, especially in those places which are heated by it, all mercantile transactions are suspended, and the most powerful boats can scarcely be trusted, except in the night or early mornings, when it is slack. On these latter occasions the levanter will sometimes become so light that it will even assume the benign influence of the land wind, and will draw to the N. E.; but as soon as the sun is up it again makes itself felt with severe gusts, and at 9 or 10 o'clock no boat can cross the bay. This mostly happens in the hot season, and at times when it is scarcely felt in the eastern entrance of the Strait of Gibraltar.

Within the Mediterranean easterly winds are generally moist, and attended with foul weather, heaping dense clouds on the mountains on the eastern side of the Strait of Gibraltar, but, from the meridian of Tarifa to the westward the

levanters are very dry and clear, especially in summer. When, in this season, they blow with the intensity above mentioned, they are attended with a suffocating heat, which obliges the people of Cadiz and its vicinity, as a protection from it, to close their houses hermetically if they can, and prevent the dust which it brings from entering their dwellings. In its course it destroys the crops and produces much ill effect on health. Within the bay it blows from E. S. E. and S. E., excepting about daylight, when it is E., or even E. N. E. While the levanter lasts the sky keeps clear; but the horizon is somewhat heavy and the land misty. If a cloud be seen it is very light and high, of the cirrus order. The sun rises and sets very dull and hazy, so much so that the eye can look at it without flinching. Dryness is its distinctive character on the western coast of the province of Cadiz; one totally different to that which it presents on it seastern shore, where it is remarkable for its humidity.

The most lasting levanters are those which establish themselves by slow and gradual progress, or which do not reach Cadiz until they have prevailed for two or three days in the strait; those which come suddenly, and perhaps with much strength, are the soonest over. In winter-time the levanters do not last so long, and at their commencement are clear, but lose this quality when they become S. E.; then they also bring heavy clouds and showers, sure signs that they will haul to the southward, and change to the vendaval, or S. W. wind.

Indications of a levanter.

The warnings of the levanter are the entire absence of dew, and the peculiar dryness of everything about the decks. In calm weather, or when the wind is very light from the westward, this dryness is very evident, and at the same time light threads of gossamer will be seen clinging to the rigging; they are sure indications of the approaching levanter. Some persons believe that these filaments of gossamer are really threads of spiders. But such is scarcely credible. If we consider the enormous quantity that the levanter brings with it while it lasts, some fine, some coarse, it is impossible to imagine that there can be such a multitude of spiders to produce them in the small tract of country between the heights of Algeciras and the plains of Chiclana. We suspect that they are a watery meteor which is imperceptible from its minuteness. The same phenomenon is

found at Vera Cruz with northers, and at the River Plata with pamperos, as well as in the interior of the continents when dry winds prevail. It is frequently observed in the country about Madrid, especially in autumn.

There are others who consider that these filaments are produced by microscopic spiders which emit them in dry winds. Masses of these filaments are found on the vessels anchored at Cadiz clinging to all parts of the rigging, some very fine and others coarser, and there are also some which are clotted and tolerably long, transparent, and also opaque, white, and generally elastic. Some are found coagulated together in the water, and all separate when taken by the hand. With close attention they may be seen to cover the surface, carried along by the wind like skeins of thread. With this same wind, the levanter, none of these are found in the rigging of vessels anchored at Algeciras. This phenomenon must have some relation to the hygrometric condition of the atmosphere. On the shores of the Gulf of Mexico in the dry season it is also observed; there these gossamers are generally called the threads of the virgin, and considered an infallible proof of an approaching norther. The same phenomena are observed in the Rio de la Plata, where they are found in the midst of fine weather with a light northerly wind and a clear sky, and are there the precursor of a pampero. The same is observed on the shore of the Spanish Peninsula. In all these cases the atmosphere is very dry and transparent, and the threads adhere to all parts of the vessel from the trucks to the sides, not even excepting the persons on board.

The experienced mariner who may be at Cadiz knows very well when the levanter prevails in the strait. If he sees on the heights of Ubrique, and the more elevated mountains of Algeciras, little white clouds like bunches of raw cotton adhering to their summits, he knows they are proofs of the easterly winds blowing in the eastern entrance of the strait. And if to these proofs are added the suffocating heat which accompanies this wind, and the dryness which belongs to it, he concludes that the levanter will soon be with him, although at the time the westerly wind may be blowing in the bay. The seamen also in the Gulf of Huelva, or off the Broa of San Lucar, know that the levanter is blowing

at Cadiz and in the strait when the sun at rising presents a white appearance, and the land is misty.

The light virazon is also a precursor of the levanter. When it is found that this daily breeze begins to decrease in strength, and when at night, hauling to the land, it inclines more to N. E. than N. W., accompanied by some light, broken clouds, it may be shortly expected. It may also be expected sooner when the heights of the distant mountains are distinctly seen. These same heights will remain clear while the wind continues to the N. E. or E.; but as soon as their summits become clouded the wind may be expected to draw to S. E., which is the wind with which the sky soonest becomes overcast. The winds which preserve the clearest atmosphere are those from N. E. to E.

The barometer will also announce the easterly wind. A small depression of the mercury in the barometer and a simultaneous rise of the thermometer are indications of the quick approach of that wind; but as soon as it has set in the mercury of the barometer again rises.

Strength of the levanter.

The strength with which the easterly wind blows increases until it passes the meridian of Tarifa; but it then soon loses its strength as it approaches Cape Trafalgar, and frequently does not even reach Cadiz. It must be observed, however, that this same strong levanter, which scarcely reaches Cadiz, continues established in the parallel of the strait to a much greater distance from its western entrance.

It is also to be noted that while the fresh levanter prevails within the strait, land and sea breezes may be blowing at Cadiz and the Gulf of Huelva, Cape Trafalgar being almost always the dividing limit of these contending winds. Thus it is common, particularly in summer-time, for a vessel to be running through the strait with a strong levanter and then into Cadiz with a fresh sea breeze. In such cases the levanter accompanies the vessel to the meridian of Tarifa, and sometimes to that of Trafalgar, losing in strength and hauling gradually to S. E. and S. until it arrives at S. W. or W. S. W. If the navigator bound to Cadiz foresees this change he does not keep along the coast, but runs on a parallel to the southward of Tarifa, so as to be well clear of Cape Trafalgar and in a good position when he catches the sea breeze to make Cadiz with it.

Sometimes the easterly wind is two or even three days in reaching Cadiz, and sometimes even although it may be

strong in the strait. Sometimes also it will reach Chiclana and Carraca without touching the mouth of the bay, where only the sea breeze prevails. But in this latter case it soon becomes general, extending over the whole coast as far as Cape St. Mary or even west of this cape. Sometimes also it does not pass the Broa de San Lucar.

Yet when the levanter is spreading as just observed it also becomes intermittent. It comes in gusts of brief duration as if it would overcome its opponent, the western breeze. In these cases vessels from the strait making for Cape St. Vincent have it partially or in gusts until it becomes general. Sometimes it does not pass the meridian of Cape St. Mary, where it generally meets the westerly wind.

On the coast of Cadiz, or between Cape Trafalgar and the mouth of the Guadalquivir, the levanter also comes in gusts, but when once established it maintains its place, and above all in summer-time, lasting sometimes as long as fifteen days together. Perhaps the only intermission of it is about sunset, and slackening throughout the night, but recovering itself about daylight and regaining its former strength as the sun gets at its height. It will thus set in with some gusts soon after sunrise, becoming stronger as the sun gets at its height, and blowing hardest about noon. In recompense for this there are some years in which this most pernicious wind will not blow for even a couple of months.

After the levanter has been blowing for some days, especially in summer, if the barometer rises it may be expected soon to cease, even if it is blowing in heavy squalls; and, in fact, it will be gone the next day and be succeeded by the wind from the opposite quarter, but this is only violent when it sets in against it.

The medina.

At Cadiz easterly winds called the *medina* often blow strong, but in April, instead of being hot and dry, they are accompanied by heavy black clouds which often give rain and hail. They come in squalls and often increase to a gale. They slacken in the evening to freshen again in the morning; blowing strong during the day with occasional sudden gusts during the night.

Westerly winds.

These winds alternate with the levanter and consequently blow at all seasons. They are distinguished by their healthy influence on the animal system, their freshness

mitigating that heat and dryness which are the effects of the levanter.

These westerly winds have an entirely opposite character to the levanters. They are moist, and generally accompanied by clouds. They never blow so hard as the levanters, nor are they so persevering, and generally slacken or go down with the sun.

In winter time, when these winds draw to S.W., they bring heavy clouds and showers, which expend themselves in wind and rain so as to obscure the whole coast; still, between the showers there are in general sufficiently clear intervals to enable the navigator to make his easting for the coast. If they draw to the N. W. they are clearer and generally last for intervals of eight or ten days.

Indications of westerly winds.

The approach of the westerly wind is marked by dews. If in the interval of the easterly wind, at night or early in the morning, moisture is seen on the different parts of the ship, proceeding from the dew, it will soon terminate, to be followed by the westerly wind.

Veering of the easterly wind by by the S. W.

In general, before the W. wind sets in, it will gradually lessen in force and veer by S. E. and S. to S. W., accompanied at the same time by a fall in the barometer. If this should happen in winter, the sky begins to become overcast as soon as the wind gets to S. E.; it blows from this point for one or two days, the barometer continuing to fall, and it finally becomes S. As soon as it gains this quarter the sky is entirely overcast; then the wind freshens up and changes to S. W., accompanied by heavy clouds and constant rain. It is in this state of the weather that the barometer is lowest, and the wind may be soon expected to veer to W. if the barometer has a tendency to rise and the rain becomes less frequent.

Baffling winds.

When the levanters enter the gulf they do so by fits and starts, and are preceded by light, baffling winds from all parts of the horizon, that are called *macareos* by the Spanish sailors. If these baffling winds are attended by a suffocating heat in summer-time, the levanter may be expected, which generally lasts some days when once it sets in, blowing hard if from S. E., while the sun is high, and drawing to N. E. at night, with fine weather. But in summer in the Seville River their heat is intolerable.

In winter-time in the Gulf of Huelva the continuance of the northeasterly wind is generally considered a sign of the

vendaval, and as soon as it passes to the eastward this terrible wind may be expected, for then it soon becomes S. E. and shifts to S. and S. W. As soon as the wind begins to veer thus, and the barometer falls, a vessel should get out of the gulf as quickly as possible into deep water, and avoid compromising her safety by getting hampered with the Arenas Gordas.

It frequently happens that while these changes are going forward in the gulf, at Cadiz and in the strait the levanter may be blowing, and on the coast of Algarve the westerly wind. When mist is observed over the entrance of the strait the levanter may be known to be outside, and the westerly wind prevails at Cape St. Vincent when the Portuguese land is clear, or if the mist be seen at the mouth of the Guadiana.

Old sailors who know the Bay of Cadiz and its neighborhood have an idea that the climate of those parts has undergone a change of late, an alteration which they consider extends even to winds and storms. They consider that of late storms are scarce in comparison with those of former times, when bad weather commenced in September and lasted until spring, when storms followed each other with scarcely any intermission.

It seems that the general tendency of storms now, almost as soon as they are established, is to slacken and not to last any time. But at any rate, both in summer and winter, the winds are more variable, and it is seldom observed that the same wind will last for fifteen days together, as, in their opinion, was formerly the case.

Storms scarcely ever get up on the coast of Cadiz, but come from other parts more or less distant. A storm at Cadiz, where it is remarkable for the force of the wind, is soon over, and in general bad weather comes from the S. E., a quarter from which the wind is much stronger than from the E.

Land and sea breezes.

These partial winds proceeding from the same causes as those which give rise to the trade-winds, are common during summer in the Bay of Cadiz. The sea breeze, as in tropical countries, is found on the coast at Cadiz in summer when the E. wind does not prevail, and is strong and lasting in the Gulf of Huelva:

On the coast of Cadiz from 9 to 10 o'clock in the morning the sea breeze sets in gradually, and veers to S. S. W. and

S. W. as the sun gains height, attaining its greatest strength when the sun has passed the meridian, or at the hottest time of the day, and gradually subsides as the sun descends, veering westerly until 8 or 9 o'clock in the evening, when it falls calm. After two or three hours of calm the land wind gets up, acquiring more strength in proportion as the coolness of the night increases. At daylight it has attained its utmost strength, and fails gradually as soon as the sun appears and begins to warm up the ground again to receive in its turn the cool sea breeze.

In the Gulf of Huelva the land breeze is from N. E. and E. N. E. in the Bay of Cadiz; while on the African coast it becomes E. S. E. When the land breeze blows from the E. in Cadiz Bay it shows that the levanter is blowing in the Strait of Gibraltar.

The sea breezes in the Gulf of Huelva begin at S. E. and leave off at N. W. In summer-time they are almost constant, and while they last a vessel will be safe off the coast, even to anchoring to obtain water, or to rest from a cruise. Off the Cadiz coast the sea breeze is not so strong, for it is subject to interruptions from the easterly wind, which is not so frequent in the gulf, inasmuch as that noxious wind does not reach so far.

Although the land and sea breezes belong to summer, they also come in winter, attended with long intervals of fine weather.

Let us now turn our attention to the winds of the coast of Portugal and Galicia.

Winds on the western coast of the Iberian Peninsula.

The prevalence of polar and tropical winds on the western shore of the Iberian Peninsula may be considered as constant, since those from N. W. and S. W. are but inflections from them, and those from N. E. and S. E. may be considered as land winds, or from the opposite quarter.

The south coast of Portugal, which forms a portion of the Gulf of Cadiz, is thoroughly persecuted by winds from the S. E. and S. W. quarters, and the dividing limit between the winds from these two quarters may be considered as Cape St. Vincent, so that a vessel doubling this cape from one side or the other finds shelter from S. W. or S. E.

In like manner, for a third part of the year, northerly winds are found to prevail, the wind varying between N. E. and N. W. fresh, with clear weather during the summer, and cloudy or showery during the winter.

From April to October the northerly winds mostly prevail, southerly winds blowing during the other months; that is, S. W. winds prevail from November to March, and which generally leave off at N. W. When in the fine season the vendaval prevails, it is moderate and seldom lasting.

Southerly and S. S. E. winds, frequent from December to March, scarcely blow for twenty-four hours; they will be light, with rain about a day, and then jump to S. W., where they remain longer, and leave off at W. or W. N. W., which will serve for either tack.

Winter winds.

The season of bad weather begins on this coast in November and ends in February. During these winter months those heavy rains take place which come with S. W. and N. W. gales. The vendaval, which is the word among the seamen of these shores to distinguish the severe weather from S. S. W. to W. S. W., brings up heavy clouds from the southward, preceded by a light mist which flies with more or less swiftness according to the strength of the wind which may be expected.

Indications of the vendaval.

When the sky is clear and small clouds appear which are very high and scattered, (cirro-cumulus,) to which navigators give the name of *cielo aborrigado*, (mottled sky,) the vendaval may be expected, especially in winter, as a day cannot pass without the sky being completely overcast, and the wind settles at S. If the vendaval is strong it will bring abundance of rain in the first twenty-four hours, and will next change to the S. W., where it will continue for two or three days, then veering to W. and perhaps to N. W., always blowing hard, but perhaps with less rain.

The appearance in the rigging of those threads called *telaranas*, to which we have alluded, is also a sign of the vendaval. These, however, are mostly limited to very fine clear weather when all is calm and quiet. When this sign appears in winter a southerly wind may be expected, which will soon freshen to a gale with rain. In summer this sign is preceded by cloudy weather and winds from the S. W. and N. W. quarters, which are those that supply rain.

There are some years when, during the whole of the winter, the S. W. and N. W. winds set in more or less strong, but always accompanied by showers, the interval of clear weather between them being brief, and in these intervals the wind will shift from N. W. to N. and N. E.; at these

points it will remain and give fine weather until it returns to S. W.

When the vendaval drops to a calm and showers cease without any wind from the N. E. the S. W. wind may again be expected, with a return of bad weather far worse than the former. But in order to have any confidence in the weather the vendaval must take its normal course, that is, should terminate at N. W., and from thence the wind should change to N. N. E. or N. E., when it would be settled for several days.

The northeasters in winter are also attended with an overcast sky and occasionally showers accompanied with snow or hail, but in general they bring clear weather. In summer, when they blow hard, they are accompanied by a mist, so that the coast cannot be seen more than twelve to fifteen miles off.

When about the end of winter the ground is saturated with wet this will prevent the vendaval from reaching the coast, and vessels which may be running from bad weather at sea to some inlet, find that the wind will change to the S. and S. E. on nearing the coast, and thus retarding their approach to it. S. E. winds, however, are rare, and when they blow in winter they are attended by heavy snow-showers and are very strong. The easterly wind is always the coldest.

The northerly winds, properly so called, vary between N. N. E. and N. N. W. and are mostly found on the west shore of the peninsula; they prevail from May to September, interrupted with light vendavals, and are almost always attended with clear skies.

The vendavals of this season, which are almost always of brief duration, generally bring cloudy weather, which does not clear away until the wind veers to N. W. on its way to N. In proportion to the density of the clouds which the vendaval brings, the less, most probably, will be the duration of the wind. Notwithstanding the prevalence of northerly winds in summer on this coast, it and especially that of Galicia is very liable to waterspouts and showers, the effects of opposing winds.

Water-spouts. These phenomena will form with an easterly wind, or perhaps with an off-shore wind at the time when the wind at sea is from S. W.; and as the clouds which this wind ac-

cumulates over the coast are driven back by the off-shore wind, a waterspout is formed.

Sometimes the waterspout is formed instantaneously, accompanied by heavy thunder and rain, for which it is necessary to be prepared by shortening all sail, for they usually are attended with much wind. These opposing winds occur in August and September, principally in summer when there is much heat.

As there are years with hot seasons on the coast of Cadiz and in the Strait of Gibraltar from the levanters, so also are there others of cold seasons from northers on the coast of Portugal. Nevertheless, in these same years there are many marked changes, which prove how difficult it is to determine the limits of the changeable wind on any particular coast.

The following table of the winds at the mouth of the River Tagus, from the 1st of October, 1863, to the end of September, 1865, formed from meterological observations made at Lisbon, will give a good idea of the winds which prevailed there for two consecutive years:

Winds.	Number of days it lasted.	BAROMETER.		THERMOMETER.		Remarks.
		Max.	Min.	Max.	Min.	
		°	°	°	°	
Calm	10	.....	.....	.....	.....	
N.....	128	30.5	29.7	76	36	They are generally clear and fresh during all the year, especially from May to September.
N. N. E	96	30.5	29.7	81.5	40	
N. E	110	30.5	29.6	85	36	
E. N. E	28	30.4	29.9	86	36	
E.....	38	30.4	29.5	81	40	
E. S. E	18	30.2	29.8	74	50	They are fresh, and attended with rain or snow from October to April, especially with winds from S. S. E. to W. S. W. Fogs are frequent from October to February, and generally with S. E. to S. W. winds.
S. E.....	9	30.2	29.4	68	50	
S. S. E.....	2	30.3	30.1	67	47	
S	28	30.1	29.6	77	49	
S. S. W.....	45	30.2	29.3	71	48	
S. W	50	30.4	29.1	68	48	
W. S. W ...	25	30.2	29.3	73	48	
W	26	30.3	29.7	78	43	
W. N. W ...	13	30.1	29.3	71	50	They are fresh, with snow. showers, and often rain, in summer. In winter fresh and showery.
N. W	49	30.5	29.8	79	42	
N. N. W ...	56	30.3	29.8	77	47	

The foregoing may be resolved into the following table:

Months of observation.	Winds of N. E. quarter.	Winds of S. E. quarter.	Winds of S. W. quarter.	Winds of N. W. quarter.
	Days.	*Days.*	*Days.*	*Days.*
1863—October	12	5	8	5
November	24	5	0	1
December	26	0	2	2
1864—January	19	7	2	3
February	12	0	11	5
March	13	3	11	2
April	12	3	6	6
May	14	5	8	6
June	15	4	3	8
July	14	5	3	9
August	18	2	5	6
September	19	6	2	3
October	8	3	17	4
November	13	3	6	8
December	5	2	4	10
1865—January	6	2	15	8
February	15	2	3	8
March	20	0	4	7
April	9	4	10	7
May	15	2	9	5
June	14	4	5	6
July	20	0	1	10
August	14	0	6	11
September	17	0	7	5
In the two years	363	67	148	144

From the foregoing we may conclude that winds from the northward, or those from between N. W. and N. E., both inclusive, have prevailed for..... 439 days.
From S., or between S. E. and S. W..... 134 days.
From E., or between E. N. E. and E. S. E ..... 84 days.
From W., or between W. N. W. and W. S. W... 64 days.

So that the prevailing winds for the period of two years were from the N., with a remarkable preponderance over the rest, and they were the most lasting in the months from May to September.

It must be noted that these observations were made at 9 a. m., a time when perhaps the wind for the day is not established according to that outside, especially in winter; and that the place of observation was the observatory,

which, besides being well up the River Tagus, (or rather, the Lisbon estuary,) is subject to the prevalence of the land wind, which commences at the lower part of the Tagus. Observations carefully made at the light-house on the Berlings will give hereafter a better idea of the winds which prevail on the western coast of the peninsula. Nevertheless, we may be satisfied from the above results that the prevailing winds on the coast of Portugal are northerly, those of the opposite quarter prevailing from October to April, and which alternate with those from W. and N. W.

Rollers is the name given by the Spanish navigators, and *vaga de mar* among the Cantabrians and Galician seamen, to the swell on the coast, occasioned by the on-shore wind, but which does not itself reach the place where it is observed. Rollers.

In the Gulf of Cadiz it is often observed, particularly in winter. A swell comes from the S. W., attracting attention by the noise which it makes by breaking on reefs. These noisy waves are the forerunners of the vendaval which prevails beyond the horizon, and which sometimes is not long in coming, bringing along with it dense and heavy clouds which darken the atmosphere, while the waves inundate the coast.

This swell is the precursor of the wind which produces it, and sometimes this wind does not reach the place where the swell is observed, being opposed by another more powerful current of air. But by the magnitude of the waves and the direction of their course, an opinion may be formed of the kind of weather which prevails in the district from whence they come, in the same manner as we can form an opinion of the wind which prevails in the loftier tracts of the atmosphere by the direction and swiftness of the clouds* which it carries along with it.

* Clouds are the surest indications of the direction the wind is following in the upper and lower regions of the atmosphere, for they show the direction in which the upper aerial currents are moving over that which we experience on the surface of the globe. The higher and lighter clouds are seen to move frequently in a direction contrary to that of the wind that is blowing below, and when this is observed we may prepare, before long, for the wind which is (as it were) thus promised, which is initiated in lofty regions, for it is certain that atmospheric currents are formed gradually from the higher to the lower parts, and in a manner more or less oblique.

From these small woolly but higher clouds, which are seen to move from S. W. to N. E., seamen know that the S. W. wind will soon follow,

On the coasts of the Gulf of Cadiz this swell is the certain indicator of the vendaval, and sometimes it will foretell the wind even for two days. On those of Portugal and Galicia, whether it comes from S. W., W. or N. W., it is always a sign of the same weather prevailing in those directions, and its presence prognosticates the coming of the wind which sends it.

There are occasions when it delays much its arrival on the coast of the peninsula, and at other times the wind which produces the swell does not come at all, for reasons already stated. But in general it is the signal of the wind which is about to prevail.

N. W. swell.

A N. W. swell is very common in winter on the western coast of the peninsula, and in March and April is almost incessant on the African coast. It is very well known to those navigators who make the voyage from the straits to the Antilles, who begin to experience it as soon as they reach the meridian of the Canaries. They consider it the result of the heavy N. W. gales which come from Davis's Strait, and they are confirmed in this opinion by the fact that when they reach the meridian of Newfoundland the swell disappears, owing, they consider, to the impediment presented by the Great Bank.

This swell makes terrible havoc on the coast of Africa, rendering it unapproachable for long intervals of time, and vessels which unhappily get on shore on that coast while it prevails soon go to pieces and the crews are drowned. Ves-

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whatever other wind may be blowing at the time, with its corresponding weather.

A still higher stratum of clouds will enable the seamen to prognosticate the wind which will follow in a district more or less extensive, particularly evident on clear nights. We allude to what are called shooting stars. From time immemorial it has been believed by navigators that the wind will come from the point of the horizon indicated by them as from whence they came, and careful observations of Mr. Coulier-Gravier, and which he is still following, partly confirm this assertion. This philosopher has observed that those meteors move in the higher regions of the atmosphere, and that they reveal the direction of these aerial currents in which they move, a revelation which coincides with barometrical indications. These currents on approaching the earth's surface disturb the most dense vapors, as is well shown by the barometer, which indicates the approaching aerial currents, and foretells the direction of those luminous displays which leave behind them the exhalations called hooting stars.—*Researches on Meteors, by M. Coulier-Gravier.*

sels which are accustomed to lie in Jeremias Bay and the coast about Larache as far as Cape Blanco for shelter from the levanters have good opportunity of observing this swell, which produces a mass of breakers on the rocks and distant banks which lie off the coast. Such heavy swell being observed by a vessel she should on no account approach the shore under sail, for she might get becalmed and would be then thrown on the reefs, or might, in order to prevent it, be obliged to drop an anchor that might never be recovered.

The N. W. swell attains colossal dimensions on the west shore of the peninsula, and on the coast of Spain. It shows itself in mountains of water of so wide a base that they attain a height of sixty to seventy feet, and acquire a force that would destroy the strongest vessels;* sailing vessels finding themselves hampered by such seas near the coast have narrowly escaped a horrible wreck by a merciful interposition of Providence, in a favorable off-shore wind, by which only they have been saved from destruction.

Barometer.

When the barometer merely shows the weight of the atmosphere, it is even then useful to consult, for the sake of knowing the changes which take place in the vast laboratory wherein the most destructive tempests and the most astounding meteoric phenomena are produced.

We know that the rising and falling of the mercury in the barometer are the result of the actual pressure of the atmosphere on the surface of the mercury contained in its cistern. A rising of the mercury shows an increase of atmospheric pressure on the surface in the cistern. This occurs with winds from the northern quarter; and, consequently, a rising in the mercury will always indicate a tendency of the wind to come from that quarter which is also always the coldest. Again, on the contrary, with a fall of the mercury

* Admiral Fitz-Roy, in the *Thetis* frigate, observed sixty-six feet as the height of the wave in a gale in the Bay of Biscay.

The following are quoted by the "*Annuario:*" The heights of waves in wide and deep seas in a gale of wind may be estimated as between thirty-five and forty-five feet from the summit to the base. There are authorities which assign forty-seven feet as the height, with a distance between them of six hundred feet, and a rate of traveling of thirty miles an hour.—*N. M.*, 1854, p. 49.

In seas not very deep, waves attain an immense height, and have been observed more than one hundred feet high near the Eddystone in the mouth of this channel.—*N. M.*, 1835, p. 609.

in the tube it rises in the cistern, showing a lesser pressure on its surface, and this is the case when winds from the southern quarter prevail, which again are also the warmest, and therefore a falling in the mercurial column is a prelude to winds from that quarter of the horizon.

Between these two extremes there is room for a multitude of gradations, according to the density or lightness of the atmosphere, and hence the study of the oscillations in the tube of the barometer enlightens the navigator in the subject of atmospheric changes, and enables him to foretell what will occur. Still it must be remembered that if for the most part the warnings of the barometer coincide with atmospheric changes, they do not always accompany each other.

Indication of southerly winds.

A fall in the barometer that precedes rain on this coast generally indicates southern winds, which are warm, and, crossing the ocean, come loaded with vapor. Consequently, the barometer falling will always indicate an expansion of the atmosphere occasioned by warm winds from intertropical regions, but gives no indication whether from E. or W. of S., or whether it will be accompanied by heavy or light rain.

Indication of northerly winds.

Again, the rising of the mercury reveals a condition of the atmosphere entirely opposite to the foregoing, because it is owing to northerly and northeasterly winds, which are always the coldest and most dense; and because they pass over large continents they come to these shores, in general, dry and clear.

The atmospheric pressure indicated by the barometer also shows us different heights above the surface of the sea. A rise in the mercurial column, or a depression of the surface in the cistern, always accompanies a depression in the level of the sea, and this is detected in the harbors where the high waters do not attain their usual level, and the time of high water is earlier. The contrary takes place when the mercury rises in the cistern, for then the least pressure raises the level of the water and the time of high water is later. Thus it is that the pilots of the ports, fishermen, and others acquainted with the sea, foretell by means of these differences of height the probability of northerly or southerly winds.

In fine weather the level of the water is much lower than ordinarily with northerly winds and a low thermometer, and

the contrary takes place when the wind is southerly and the temperature high. All this is observed most satisfactorily in the ports of the Mediterranean which are not subject to tides.

When the barometer rises or falls slowly for two or three consecutive days, its indication may be most assuredly depended on; but rapid changes indicate wind or bad weather.

The thermometer generally follows its movements in a manner contrary to those of the barometer; that is, it rises when the barometer falls, and *vice versa.* A high barometer and a low thermometer always foretell northerly winds; and barometer low with thermometer high, southerly winds.

The changes of the barometer off Cadiz are very remarkable. In the course of five years' observations in the Tower of Tavira it never varied above an inch. In January, 1858, it attained its highest reading with a northerly wind and clear sky; and it was at its minimum in November of the same year, with a heavy southwester and torrents of rain.

Other observations made at the Astronomical Observatory of San Fernando, at eight every morning, from the first of January to the end of July, 1865, show that the whole range of the barometer was 1.024 inch; the highest, which was 30.6, occurred in February, 1864, with an E. N. E. wind, light, thermometer 38°. The lowest was 29.5 in March of the same year, with strong southerly winds and rain, thermometer at 54°.

In the Gulf of Cadiz the changes of the thermometer are very small. The small variation of its climate is its best praise. Situated in a temperate part of the world, and far from the snowy peaks of mountains, it is not subject to much change of temperature. The sky is mostly clear and but little rain falls there. Nor is it much visited by thunderstorms. But it has a reminder of the levanter of which we have already spoken.

This vapory condition of the atmosphere is another of the enemies which the navigator has to contend with, very often to his loss, for they not only blind him to external objects, but at the same time allow him to be driven along with the surface current of the ocean. Fogs.

According to scientific men, fogs are occasioned by the difference of temperatures between adjoining regions of the ocean, and their occurrence is at the mouths of estuaries, the land in the vicinity of which sends forth a vapory atmos-

phere which is condensed with the cold atmosphere of the low capes.

The coasts of Galicia and Portugal are much visited by fog, and principally at the mouths of the estuaries. But they are most frequent in moderate and wet winters.

In the Gulf of Cadiz they are occasionally very enduring, especially at its western entrance. At the termination of the easterly wind they usually occur there, appearing like a barrier to it, gradually advancing to the eastward until they completely cover it, and clearing away as soon as the westerly wind is fairly established.

The fogs which collect about daylight at the mouths of the estuaries of the Portugal and Galicia coasts generally clear away about noon.

Fogs on the African coast.

On the coast of Africa there are also, in the early morning or later, these same fogs, and generally with N. E. winds. Sometimes they will extend over the entire strait, forming in the western part of it like a wide curtain, and as night approaches completely cover the whole coast.

Sometimes they are so close down to the surface of the sea that it is common to see the masts and rigging of vessels above these fog banks, while their hulls are entirely concealed by them. Fortunately this occurs in quiet weather, when vessels under sail make little or no progress, which adds to the chance of bells, fog-horns, or any such noisy instruments being heard, and thereby keeping clear of each other, numerous as they may be, as in the Strait of Gibraltar.

Nevertheless, these precautions are not always sufficient to prevent collision between vessels, for the streams of the currents will drift several at once, occasioning their fouling in spite of their attempts to prevent it; and if on these occasions there should be added a strong tide, the consequences become still more serious.

Steamers under such circumstances slow their speed, making their positions known by the steam whistle, and generally suffer least, as they always have the means of keeping out of each other's way.

Haze.

A hazy state of the atmosphere is almost as bad as fog, if happily it is not as dense. This occurs in times of great heat, and on the coasts of Portugal and Galicia is most frequent with N. E. winds.

In the summer-time in the Gulf of Cadiz, especially with light southerly winds, the haze on the horizon is considera-

ble, and the effect of it on vessels and buildings near the sea is so great as to alter their form in appearance, and throw out the points of the shore as if they were lifted above the water. A considerable amount of haze generally indicates humid and wet weather, and easterly winds with a tendency to the S.

During a dry winter in these localities, thick fogs will occur and the shore cannot be seen except at a very short distance.

A general fog, more tepid still, will occur at this season with the vendaval. These become so extensive as to cover the whole coast under consideration.

Navigators who make the land under these unfavorable circumstances are frequently at a loss to determine what land it is they have in sight, the heights of the interior being concealed from them. Even the objects on the shore are so distorted that white towers and such like buildings are often mistaken for vessels under sail. And if the coast they are on have outlying reefs and are shoal to approach, they are in the risk of getting aground, unless some break indicates their presence.

The Strait of Gibraltar, connecting the Atlantic Ocean and the Mediterranean Sea, may be considered as extending, on the European coast, from Cape Trafalgar to Europa Point, and on the African coast, from Cape Spartel to Point Almina of Ceuta. It takes a direction nearly east and west the western entrance, between Capes Trafalgar and Spartel, being twenty-three and one-third miles across; the eastern entrance, limited by Europa Point and Point Almina, is twelve and one-fifth miles, and the narrowest part of the strait, between Point Canales and Point Cires, is seven and one-half miles.

Winds in the Strait of Gibraltar.

The prevailing winds in the Strait of Gibraltar are from E. and W.; those blowing from other directions are inflected at its entrances, and follow the trend of its shores, as is most always the case in narrow channels bounded by high lands. It may then be said that the general winds of the strait are those from E., varying from N. E. to S. E., and those from W., varying from N. W. to S. W.

It appears from observations taken at Gibraltar, that from 1810 to 1815 there were one thousand one hundred and seventy-three days of easterly, nine hundred and fifty-one days of westerly, and sixty-seven days of variable

winds. From 1816 to 1825 the number of days of easterly wind was one thousand seven hundred and seventy two, while the wind prevailed from the westward for one thousand eight hundred and eighty-one days. During the first period of six years it will be seen that the number of days of easterly wind exceeded those of westerly, while during the latter period of ten years the number of days during which the winds were westerly exceeded those in which they were from the eastward.

Observations taken from 1851 to 1855 give six hundred and two days of easterly, and seven hundred and forty-five days of westerly winds.

This result, compared with the preceding, would seem to indicate that from the year 1810 the climate of Gibraltar has undergone a change, the consequence of which has been the prevalence of the westerly over the easterly winds.

Observations made simultaneously at the Royal Observatory at Cadiz and at Gibraltar, during a period of six years, from 1851 to 1855, give at Cadiz, five hundred and forty-four days of easterly winds, nine hundred and six days of westerly winds, two hundred and two days of northerly, and two hundred and thirty days of southerly winds, including in the winds from the eastward those blowing from N. E. to S. E., in those from the westward the winds from N. W. to S. W., and in those from the N. and S. the winds varying from N. N. E. to N. N. W., and from S. S. E. to S. S. W. From these observations it is seen that at Cadiz, as well as at Gibraltar, the predominant wind is from the westward; but, at the same time, that the proportion of the number of days of westerly compared with those of easterly winds is much larger than at Gibraltar.

As navigators are principally interested in knowing the general average of the direction of the winds during the different months, the following table is given, which is a summary of observations made at Cadiz and Gibraltar from 1850 to 1855, together with those made on board the French surveying steamer *Phare* while engaged in a hydrographic reconnaissance of the Strait of Gibraltar:

Months.	GIBRALTAR.		CADIZ.		GIBRALTAR.	CADIZ.
	Number of days of E. winds.	Number of days of W. winds.	Number of days of E. winds. (N. E. to S. E.)	Number of days of W. winds. (N. W. to S. W.)	Number of days of variable winds.	Number of days of variable winds.
January	8.2	20.6	6.7	12.3	2.2	12.0
February	11.2	16.1	8.8	10.6	0.7	8.6
March	16.0	13.6	7.7	16.1	1.4	7.2
April	12.2	17.3	10.2	13.8	0.5	6.0
May	7.3	23.3	4.4	20.2	0.4	6.4
June	11.8	16.6	7.7	18.5	1.6	3.8
July	18.5	12.2	6.9	19.9	0.3	4.2
August	19.5	11.0	11.8	15.5	1.5	3.7
September	17.3	12.6	11.0	15.7	0.1	3.3
October	12.7	17.3	9.8	14.2	1.0	7.0
November	10.5	17.8	8.5	11.4	1.7	10.1
December	15.0	13.5	13.4	7.0	2.5	10.6

From this table it would appear that at Gibraltar the easterly winds prevail during July, August, September, March, and December, while at Cadiz the easterly winds only predominate during the month of December. It is also evident that, although Gibraltar and Cadiz are separated but by a short distance, the winds blowing at the same moment in these two localities are often different. It is then a mistaken idea for vessels bound to the west coast of Africa, on finding the winds holding to the W. to return to Gibraltar to await an easterly wind to enable them to communicate with places on that coast, as it would appear that Cadiz, or even Tangier, were preferable localities to judge of the weather there.

Tangier.

It would be very desirable for the interest of navigation to have observations on the winds at Tangier, made simultaneously with those at Gibraltar, in order to ascertain whether the same differences in the winds exist at the western part of the strait as between Cadiz and Gibraltar. Captain Luyando, of the royal Spanish navy, made some observations in 1825, which, compared with those made at the same time at Gibraltar, would indicate a considerable difference. During that year there were at Tangier one hundred and ninety-five days of westerly, one hundred and thirty-four days of easterly, and thirty-six days of variable winds, while at Gibraltar there were but one hundred and

eighty days of westerly winds and one hundred and eighty-five days of easterly.

These results would lead to the supposition that the westerly winds increase and the easterly diminish at Tangier; the easterly winds, however, always predominate at Tangier in July, August, September, March, and January. A very much larger number of observations would be necessary to arrive at any definite conclusion, as during the period of the observations made on board the French surveying vessel, the *Phare*, there was no difference remarked in the prevailing winds through the extent of the strait.

The season of bad weather.

The months of February and March are the only ones that are generally called bad for the navigation of the strait; though bad weather occurs toward the end of October, and sometimes in November, the time of the short rainy season, which lasts fifteen or twenty days.

During the winter months, January, February, and March, there are often gales of wind from the S. W., varying by the W. to N. W., or from the S. E.; these are sometimes very violent and accompanied by heavy rains, but they are not generally of long duration, though in February and March they succeed each other at short intervals.

The levanter in the Strait of Gibraltar.

In the Strait of Gibraltar, and within the Mediterranean, the features of the easterly winds are very different from those of the same winds in the Gulf of Cadiz; they come in squalls, however, near the land, but in the middle of the strait they are uniformly strong. Often, even near the shore, and principally in the bays, it is calm morning and evening, or there are light land breezes; while outside, and especially in the middle of the strait, the wind continues with its full force. Thus from the anchorage the weather in the strait cannot always be known.

The easterly winds, instead of being dry, as in the Gulf of Cadiz, are very moist; they are always accompanied by mists on the land, which become thicker as the wind freshens, and dense clouds are heaped up on the mountains of the eastern part of the strait. The dews are heavy, the mist over the land, and particularly the patches of mist which form on the heights of Gibraltar and on the summit or flank of Apes Hill, are, nearly, a certain indication of the near approach of a levanter, and while it lasts these features remain.

During the fine season easterly winds seldom bring rain

in the strait. These winds being always more moist at its eastern than at its western entrance, it often happens that the clouds of mist formed about the summit of Gibraltar and Apes Hill occasion rain at the foot of these mountains when the sky is clear in the strait. If, during the fine season, particularly in June, after the easterly winds have blown strong, round clouds with white borders collect in masses about the land, if the wind goes to the S. W. or W. in a light breeze, then, most generally, a thick bank of fog forms at the western part of the strait, and, as it advances upon the land, it envelopes the whole strait. These fogs are sometimes as thick and as moist as those met with in August on the Newfoundland banks; but in the strait they generally last but a few hours, and they disperse almost as rapidly as they form.

Westerl winds.

During the fine season the westerly winds are most generally moderate; then the sky is ordinarily clear and the land well defined. If they freshen, the weather quickly becomes overcast, with squalls of rain, and sometimes of wind and rain. A heavy sea then gets up in the strait. However, it can be said that during the fine season, with the exception of an occasional blow from the S. W., hauling by the W. to N. W., which are never of long duration, the W. winds bring fine weather for the navigation of the Strait of Gibraltar, and that it is principally in October, November, and December that these blows happen.

The westerly winds, generally very moist at the western entrance of the strait, are most frequently dry at Gibraltar.

When the summits of Gibraltar and Apes Hill are seen clearing of the clouds which continually cover them during a levanter, it is an almost certain sign that the W. wind is about to be re-established. During the fine season, the easterly winds are always fresh in the straits, while those from the westward are most frequently moderate. But both easterly and westerly winds have this peculiarity, that near the coast they follow its direction; thus, with fresh westerly winds in the middle of the strait, the wind is from N. W. near the coast of Spain, and from S. W. near the African coast. In the same manner the easterly winds bend toward the N. E. near the Spanish coast, and to the S. E. near the coast of Africa. It is remarked that the winds penetrating into the strait are stronger as they reach its narrowest part. Thus the easterly winds, often light between

Gibraltar and Ceuta, become very strong between Tarifa and Point Cires, as well as in all the western part of the strait. In like manner, westerly winds, moderate between Trafalgar and Spartel, acquire their greatest force to the south of Tarifa, and through the whole eastern part of the strait.

S. W. winds.

During the bad season, in February, March, and April, the westerly winds blow in violent gusts, and bring squalls and heavy rains. There are also during this season gales from the E. hauling to the S. E., and accompanied by rain in torrents. The weather is almost always overcast.

The worst winds are those from S. W.; in the squalls which accompany them they shift suddenly to the W. and N. W., and even to the N. and N. N. E., without abating in force. When they become settled between N. and W. they are generally more moderate. The squalls bring rain, sometimes hail and violent gusts of wind. Between squalls it clears, and the wind moderates in the interval. If the wind becomes settled between N. W. and N. E. it moderates rapidly and the weather clears; but if, on the contrary, after flying to the N. W., the wind should return to the S. W., it most frequently doubles its force, and the rain continues to fall in abundance.

Winds from N. W. to N. E., changing by the N.

Winds from N. W. to N. E., changing by the N., are rare. They bring fine, clear weather, when they are moderate. In the bad season they blow most frequently with violence. The pilots state, however, and it appears to be the case, that though the N. W. winds may blow with violence in the strait, they seldom penetrate into the road of Tangier.

During the bad season the N. E. winds frequently bring rain, and when they turn to the E. and S. E. they become, generally, gales of wind.

S. E. winds.

The most rain is brought by the levanters blowing from the S. E. They blow in squalls, shifting suddenly to the N. E. and even to the N., without abating in violence; sometimes they moderate on passing to the N. E., but if then they should return rapidly to the E. or S. E. the bad weather will continue.

Storms.

In September and October storms are most frequent in the strait. In April, May, and November they are less common, and are rare during the other months. They come up generally during the evening, afternoon, and sometimes at night. The weather there is very unsettled, and the wind

very variable. Heavy gusts of wind frequently come from opposite directions, lasting but a short time. The upper clouds will then frequently be seen moving in an opposite direction to the inferior ones, which is an indication that the evening will not pass without a storm.

During September and October, the pilots affirm that fifteen or twenty miles outside the strait the weather is generally squally, with rain, and most frequently accompanied by gusts of wind. Sometimes, they say, these squalls only contain rain with lightning, calms, or light, variable breezes. But it is prudent to distrust this weather in a vessel under sail, for when these squalls bring wind it assumes the character of a whirlwind and shifts suddenly four, six, or even eight points, blowing with increased violence as these shifts are more sudden and more extended. The pilots call these whirlwinds *remolinos.*

Squalls.

When navigating the Strait of Gibraltar, or in its vicinity, with the wind from the E., it is necessary to keep a lookout for the squalls, which are frequently very violent to the westward of the Rock of Gibraltar, in the vicinity of Apes Hill, as far as Point Cires, near Point Malabita and in the Bay of Tangier, to the westward of Tarifa, and near the coast of Spain, between Cape Trafalgar and Cadiz.

With westerly winds the squalls are to be feared when to the eastward of the Rock of Gibraltar, near the west shore of the Bay of Algeciras, principally crossing the Bay of Getares; in the vicinity of Apes Hill, in the bays of Benzus and Ceuta, on all the coast between Ceuta and Tétouan.

The sea.

In the Strait of Gibraltar, beside the sea produced by the wind actually blowing, the swell of the ocean, resulting from the prevailing winds outside, is almost always felt. But in proportion as these long seas penetrate into the strait, they follow the trend of the coast and take an entirely different direction from that originally given to them by the prevailing winds. Thus with the wind from W., varying from S. W. to N. W., the swell penetrates into the bays on the coast of Africa, and appears to come from the N. W., although the wind outside may be from S. W. In the same manner, with the wind from the eastward, varying from N. E. to S. E., in the ports on the coast of Spain, the swell appears to come from the S. E., though the winds which produced it may be from the N. E. It results from this: that there is not a quiet anchorage, either on the Spanish or on the Afri-

can coast, and that the direction of the wind outside cannot be judged of by the direction of the sea running into the bays.

In the Strait of Gibraltar, as well as in the bays, always, when the swell comes from the N. E. or S. E., it may be considered as an almost certain indication of the approach of easterly winds, and of westerly winds if it comes from N. W. or S. W.

Rain.

The observations made at Gibraltar and Cadiz indicate as great a difference in the rains as in the winds of the two localities. Thus, while at Gibraltar, as a mean for each year, 68.6 days of rain may be expected, at Cadiz there would be only 18.3. The following table is a summary of the observations taken at each of these places for a series of six years, and shows the number of days of rain in each locality. Added to it are observations made on board the French surveying vessel, the *Phare*, during the years 1854–'55. These last may belong to an exceptional year, and from the different results obtained, may show how much the number of days of rain in the Strait of Gibraltar may differ from one year to another:

Table giving the number of days of rain.

Months.	Gibraltar.	Cadiz.	The *Phare*.	Observations.
			1855	
January	9.1	2.5	15.5	The *Phare* was at the anchorage of Carraca and Cadiz from the 17th of February to the 20th of April; during the other months she was in the strait and its vicinity.
February	7.1	1.6	18.0	
March	6.2	2.0	12.0	
April	10.1	1.7	4.3	
May	6.1	1.6	3.5	
June	1.8	0.2	0.7	
July	0.4	0.0	0.7	
August	0.9	0.2	0.2	
September	2.9	0.7	2.5	
October	5.7	2.0	3.0	
November	9.5	3.8	9.0	
December	8.8	2.0	0.7	

From this table it would appear that the most rainy month at Gibraltar was not that in which the most rainy days occurred at Cadiz. It is certain that, with the wind at S. W., it rains at Tangier when the weather is dry at Gibraltar, and that often the winds from the E. bring rain over the eastern portion of the strait which does not extend to the western part. Two rainy seasons are generally recognized

in the Strait of Gibraltar. The one sometimes commences in November and sometimes in December, or even in the first days of January, and rarely lasts more than fifteen or twenty days. The weather then becomes fine until the heavy winter rains, which sometimes last until May.

In 1854–'55, the season of light rains took place in November, and December was quite dry. The rains then recommenced in January and lasted until the 15th of April.

The barometer.

During the summer the indications of the barometer amount to little or nothing in the strait, but they rarely deceive in the winter. When the barometer falls, wind or heavy rain should be expected. It is usually high, with winds from N. N. W. to N. N. E.; changing by the N., it keeps up with fresh winds from the N. E., even when they bring rain. But it falls as soon as the wind turns toward the S. The winds from S. W. and S. E. being those which generally bring bad weather in the strait, they are indicated by a sensible fall of the barometer. Frequently this fall only indicates heavy rain, as generally the oscillations of the barometer are more frequently occasioned by the approach of rain than by wind.

CHAPTER II.

CURRENTS AND TIDES.

Currents in the Bay of Cadiz.

It may be said that in the Bay of Cadiz there is a general current running from S. to N. and from N. to S., inclining to either quarter, according to the direction of the wind that is blowing, or that which is about to blow; for sometimes the current runs in anticipation of the wind, which will afterwards add to its strength, and the navigator satisfies himself of the quarter from whence the wind will come by the direction of the current.

It is only in the immediate neighborhood of the mouth of the Strait of Gibraltar, and within it, that a constant current is observed setting to the eastward, occasioned by a small difference of level supposed to exist between the ocean and the Mediterranean in consequence of the expenditure of water in that inland sea from an excess of evaporation beyond precipitation; a loss which the Atlantic resupplies.

Major Rennell, in reference to the above current, considers that, in the space between the parallels of 30° and 45° N., and to the east of the meridian of 14° W. longitude, there is a tendency of the waters of the Atlantic to set toward the Mediterranean at a rate varying between twelve and twenty miles in the twenty-four hours.

Señor Tudure considers this somewhat of an exaggeration, and says that if, with the above data, we reduce to figures the surface of the ocean in question, we shall find it represents forty-two thousand square leagues; and however superficial we may allow the stream of this extensive surface to be as it runs toward the strait on reaching its mouth, so large a volume would be collected that it would not be sufficiently large to receive it, and the result would be that the neighboring shores would be inundated, and the strength of the strait current would be more than we could calculate.

That there is a perpetual current in the Strait of Gibraltar is no doubt a fact proved by every day's experience; but sometimes even this current is quite insignificant, it is only felt at its edges, and a few leagues to the west of the entrance it is scarcely perceptible.

Every day's experience, and history itself, informs us that

this current is of no great dimensions. The ships which suffered by loss of masts and sails after the battle of Trafalgar, far from being swept into the Mediterranean by this supposed current, drifted to the coast of Cadiz and the Gulf of Huelva, and the pilot of the felucca *Real Carlos*, burnt within the strait in the year 1801, reports his being thrown on Tangier Beach, instead of having been carried away by that current.*

The difference of level between the two seas is not so much as would occasion any extraordinary current; and it might altogether have escaped observation if the constantly easterly set had not suggested it. Vessels that have been perpetually cruising off Cadiz and its vicinity on many occasions have never troubled themselves about the easterly current, for it has never affec d] em, and they have been concerned only about being set into the strait when becalmed in the mouth of it.

Polar and equatorial currents.

When the ocean waters run from S. to N., by this movement they most likely reduce the atmospheric pressure experienced then in the polar regions, originated by the intertropical winds. The S. W. wind, with its impulsive force, would naturally affect the direction of the current setting northward and compel it to run to the N. E., and drift vessels over to the African and European shores. Then an atmospheric reaction takes place that acquires a very low temperature in the northern latitudes and exerts a considerable pressure on the surface of the sea, compelling its waters to flow toward temperate regions, where there is also going forward a constant displacement arising from evaporation. By this new change of place the current from N. to S. is formed, impelled by the N. W. wind, which is an inflection of that from the N., and it consequently assumes

* This accident occurred within the strait in the night of the 12th of July. The *Real Carlos*, supposing that she was engaging one of the enemy's vessels that were hovering about the rear of the French and Spanish squadron on its way from Algeciras to Cadiz, attacked her companion, the *Real Hermenegildo*. Unfortunately the mistake was not discovered until they mutually closed to decide the action, and both were burnt, nearly all the crew of both being lost. Forty men were saved by a boat, and six or seven in the fishing boat belonging to the crew of the *Carlos*, picking up also the second in command of the *Hermenegildo* from the water. The pilot above mentioned was also saved.—*La Marina por Travieso*, vol. 3, Madrid.

a S. E. direction, which also throws vessels on the coasts above mentioned.

In the perpetual transfer of the waters as thus stated, the different currents take place as we find them on the coasts, assuming that direction which their bays, islets, and channels impart to them.

In the open sea doubtless the winds play a random game in directing the currents. When after a calm any particular wind sets in, the surface waters make a slight wave, carrying them gradually to leeward, their magnitude being proportioned to its strength, until waves of a considerable size are formed, which agitate the ocean to great depths; and seamen know pretty well the force of these huge masses of water, which sometimes may be a hundred feet in depth.

Constant currents.

Certain it is that there are currents following constantly the same direction, that will be running against the prevailing wind, like those of the Bosphorus, the Strait of Gibraltar, the Florida Channel, &c. But these are but the results of physical causes and peculiarities affected by the form of the seas or gulf adjacent to the Atlantic.

The ocean current scarcely ever changes its direction so readily as that of the atmosphere, as one would expect from the difference in density of the two fluids; but the equilibrium of the waters being once re-established, they obey the impulse of any agitating cause.

It is often observed that before a wind comes home upon a coast the waters are moving in the same direction as if they were driven by it, and the navigator finds this out before the wind has come.* It is then that the current is the prelude to the wind which is coming, in the same way as the swell indicates the wind which produces it; and should this not have arrived at the place of observation, it is no reason that it should not be found in another locality perhaps not very far away.

Currents from the southward.

When the S. W. wind prevails in the Atlantic in the vicinity of the strait, which wind expands the atmosphere, the level of its surface is raised, and that of the Mediterranean not being raised by the same cause, the difference of

* There was a remarkable instance of this in the China Sea in the loss of her Majesty's ship *Reynard*, in 1851, Commander P. Cracroft. A current had been setting this ship for a whole day in a calm towards the Paracels in the China Sea, a heavy gale following it the day after, which was the occasion of her loss.—Ed.

level becomes greater and the easterly current stronger. But both levels obeying equal pressures from their contiguity, it may be said the difference of level is constant. However, a stronger easterly current is always found when the wind is blowing hard from the westward, and this has its explanation.

Always when these winds are general in the Mediterranean the waters accumulate in its interior, and in some places attain an extraordinary elevation.* This accumulation toward the interior naturally occasions a deficiency at its western end, which the Atlantic has to make up. But the wind ceases and takes the opposite direction, causing a lower level in both seas, and even a temporary paralyzing of the easterly current. It is well known that occasionally the current through the strait from the Atlantic is N. E., and that this will occur when a strong levanter is blowing in the Mediterranean, which produces a transfer of the waters contrary to that which we have pointed out.

During the hard vendavals a strong current runs from S. to N. in the Gulf of Cadiz that assumes the direction of the coast off which it runs. On the African coast it takes a N. E. direction, N. and N. N. W. on the coast of Cadiz, a small portion penetrating the strait, and the rest running N. W. and W. by the Gulf of Huelva and the Algarve coast; passing Cape St. Vincent it joins the general current. In the middle of the gulf its direction is N.E.

After this mass of water, which comes from the intertropical regions, has made this passage within the Gulf of Cadiz, it mingles with the larger mass passing outside, and both run along the coast of Portugal and Galicia, following its sinuosities; then passing Capes Finistère and Prior, run along the Bay of Biscay and enter the English and St. George's Channels, to be expended in the northern seas. It is certain that with the above-mentioned winds strong currents are experienced in those channels, and in the estuaries and ports of their coasts there are astonishing accumulations of water.

The current of which we are speaking affords us good evidence of its efforts by the great rise above the ordinary level of the sea in the Gulf of Cadiz; for in its bays, ports,

* Vice-Admiral W. H. Smyth quotes elevations of twelve English feet on the coast of Tuscany with strong *labeches*.

and estuaries it exceeds by two and three feet the usual rise, and makes the establishment or hour of high water later. This extraordinary rise of itself reveals a current. Still this accumulation in the gulf has its limit, and the waters which it cannot contain, repelled by the coast of Cadiz, escape to the westward to mingle with the current running northward.

Losses occasioned by this current.

To the effects of this current may be attributed the wrecks of the dismasted ships after the battle of Trafalgar, which was followed by a vendaval; and also of many ships considered to be running safely along the Spanish coast for the Strait of Gibraltar, terminated their career on Conil, Santipetri, and other reefs, especially before the lighting of the coast was general.

We may also cite the case of a Spanish merchant ship, which, confident of the reckoning, and expecting to make Cape Spartel at daylight, found herself nearly in the midst of the breakers of Santipetri, and owed her safety to the weather enabling her to double Cape Trafalgar and to make for the strait.

Vessels from the Strait of Gibraltar making for Cape St. Vincent with southerly winds, frequently find themselves too near the shore in the Gulf of Huelva, a condition w l irequently happens with coasting steamers, and they find from experience that with those winds they have to give the shore a good berth on their way from Cadiz for the strait, or for the above cape. In this last passage, if they do not take the necessary precautions, they find themselves hampered with Cape St. Mary, and in general overrun Cape St. Mary, owing to the current setting them to the westward.

Vessels obliged to wait off Cadiz in a hard vendaval, whether cruising or for any other reason, must not depend too much for their position on the reckoning; for they will always find themselves set into the Gulf of Huelva, and will become entangled with the Arenas Gordas when they are considered to be on the meridian of Cadiz. In such cases it is necessary to carry all the sail possible to keep to windward and compensate for the current, and more readily gain the parallel of the strait.

Strength of the current in the Gulf of Cadiz.

The strength of the current in Cadiz Gulf in a strong vendaval may be safely considered at a maximum of two miles an hour between Capes Trafalgar and St. Vincent in a N. E. and northerly direction in the middle of the gulf, and

in a N. W. direction in the vicinity of the coast. This being the case, it is always better to avoid lying by the wind too long in a vendaval between Capes Trafalgar and Santa Maria, it being far better to get into Cadiz if possible, or keep in the mouth of the strait to run in, if it should be convenient.

In the usual weather when the land and sea breezes alternate with easterly and westerly winds, the currents are not strong in Cadiz Gulf. With established easterly winds the tendency of the waters is from E. to W., and the reverse with westerly winds, excepting in the western mouth of the strait, where the current is always easterly. On the coast no other current is known than that of the tide, and this is more or less strong and of greater or less extent off shore, according to the age of the moon.

Northerly currents.

After several days of hard southerly winds, those from the opposite quarter get up; the ocean waters experience the same reaction; and although the current does not so readily change its direction as the wind does, it nevertheless soon stops and follows it, to make good the equilibrium in the equatorial regions by obeying the impulse of the N. W. wind.

On the northerly wind establishing itself after the southerly wind has ceased, it brings with it the cold atmosphere belonging to it; and in consequence a greater atmospheric pressure on the surface takes place. The waters coming from the northern seas naturally seek their way to the southward; and as the current is thus formed by the aggregate force of the wind from the polar regions, a current from N. to S. is produced with the same strength as we have already mentioned.

If the wind has a tendency to come from the N. E., the pressure of the atmosphere will be greater and the surface will have a considerable depression of level, probably as much as it acquires in elevation with the opposite wind.

The current which ebbs then from the English and St. George's Channels combines with the general current and that from the Bay of Biscay, (where the depression produces a remarkable difference of level,) running together in the offing of the coast of Portugal, a portion entering the Gulf of Cadiz, through which it flows, and taking its course afterward along the African coast.

In the Gulf of Cadiz with this current there is no risk

whatever, for it rather sets vessels from the coast, and is never so strong as the current of the S. It is observed if a considerable lowering of the level of the sea takes place in the bays and harbors, that high water does not rise to its usual height and the tidal hour is earlier.

If the wind should have a tendency to the N. W. there is also a depression of the waters from N. to S., but not so considerable. With this wind, very strong sometimes, the waters are transferred to the S. E., a portion of them passing into the Bay of Biscay, where indeed they accumulate, producing an easterly current along the shore and making it southerly along the Portuguese coast.

It may be concluded that the N. W. wind falling obliquely on the general current from N. to S., compels it to take a S. E. direction. When this current falls on the Spanish shore its N. W. front is divided, the coast obliging it to take two directions, one part running to the eastward along the shores of Cantabria, and the other to the S. along those of Galicia and Portugal.

Currents on the western coast of the peninsula.

On the western shore of the peninsula the currents are strong, and in its immediate neighborhood run from S. to N. and N. to S., according to the prevailing wind. But in the offing they incline to the N. E. or S. E., according as the wind may be S. W. or N. W. Against these on-shore winds vessels must therefore take precaution, for if the S. W. wind is blowing, or even the N. W., the vessel will drift to the shore. Experience has shown that allowance must be made for drift by steering more westerly courses than the lay of the coast would require to keep clear of it, especially when it is blowing hard.

Current previous to the wind.

It is observed on the coast of Galicia, and the same would naturally occur on the coast of Portugal, that, on one or even two days previous to a gale, the current sets toward that point of the horizon from which it will eventually come; that is, when the current sets to the S. without any apparent cause, the vendaval will come in a gale, and a similar result follows when the current sets to the N. So that the fishermen who have most to do with allowing for currents know very well by them, when a N. E. or S. W. wind is about to set in.

Strength of currents on the western coast of the peninsula.

The current generally produced by the wind sets to the N. E. and N. when that is from any point between S. and W. and it sets to the S. when the wind is anywhere between

W. and E. by the northward. In winter the current sets mostly from some point between N. and E., and in summer from some one between N. and W., and its hourly rate is about two miles, and even more with a strong vendaval.

The navigator who finds himself off Cape Finistère with a vendaval to beat against, must be careful of the shore in bad weather, for he will be drifted insensibly to leeward until he has passed Cape Prior.

With respect to ships off Cape St. Vincent bound toward Cape Finistère, with fresh N. E. winds, they will find enough to do to overcome the current they will meet with along the coast. And with fresh N. W. or S. W. winds, there is also a rise in the level of the sea in all the estuaries and ports of the peninsula, the reverse of what takes place at Cadiz and in the Bay of Biscay with N. E. winds.

Tides.

This phenomenon preserves all its regularity on the shores of which we are treating, and a supplement of waters, as the pilots call it, can only be observed when N. W. winds prevail. That is, when the said winds prevail a large mass of waters is accumulated in Cadiz Bay, and every high water rises above the usual level and makes the time of high water later. The same occurs on the coasts of Portugal and Galicia, and this delay in the time of high water and increase in the rise of the tide becomes greater the further it is to the northward.

Propagation of the tidal wave.

The tidal wave of flood, as it flows from S. to N. in the Atlantic Ocean, naturally enters the Bay of Cadiz before it reaches the Portuguese coast, as well as that of Galicia. This progress of the waters originates a current called tide, which, on the African coast, spreads itself according to its configuration; that is, from S. W. to N. E.; in that of Cadiz from S. to N., inclining to the N. W., according to the trend of the coast, and finishes by running to the W. on the coast of Algarve, doubling Cape St. Vincent, from whence it takes a northerly direction along the coast of the peninsula. All this takes place on the flood, for on the ebb the water retraces the above course in an opposite direction, and the various currents it forms also assume the opposite directions.

The current of tide runs only at a short distance from the shore, and only surpasses this distance at the heads of the tides.

The general currents above described in no way interfere

with this singular phenomenon, and only tend to increase or diminish its current when favorable or unfavorable.

Equinoctial tides.

When the high water of the syzygies happens near the vernal equinox (March) and a heavy vendaval is blowing, so considerable a rise of tide takes place in the bays and ports that the jetties and the low lands about the shore are inundated, and sometimes considerable damage is done. At Cadiz not only are the highest parts of the sides of the jetties whitened by the foam, but the sea also threatens the very walls of the city. The current of the flood is more or less increased in such cases, and the tidal establishment of the port is delayed.

Strength of the tidal stream.

One mile an hour may be accepted as the mean velocity of the tide at spring tides on the coasts of which we have been treating, but in the channels it reaches to three and even four miles an hour, according to their direction. And the same takes place on the ebb.

In the vicinity of the western entrance of the Strait of Gibraltar the ebb is always stronger than the flood, and its strength increases in proportion as it has passed Cape Trafalgar.

Establishment of the port.

Such is the name assigned to the hour of the first high water immediately after the noon of the day on which the syzygies occur, or rather, perhaps, the days of conjunction and opposition of the moon. This hour is nearly constant for the same place in normal conditions of weather, &c., and the observations for its determinations are confirmed at the anchorage, and also at the bars over which the tide passes.

Variation of time of tide.

However small the difference from the normal character of the weather, the actual period of high water varies a good deal, being affected according to atmospheric pressure and the effect of the wind. In consequence of these variations, the hour of high water is later, because there is a larger collection of waters, while at other times it is earlier, because there is less, a consideration which should be allowed in foretelling the time of high water when a vessel intends entering a port of small depth, and where it is indispensable to go in precisely at high water.

The establishments of the ports are drawn up in tables for the use of navigators. The times stated in them are always the means of a multitude of observations made under favor-

able circumstances at every place; and the navigator must make allowance for the earlier or later period of high water, according to the actual condition of the weather.

In bays and harbors of considerable depth, such differences may be neglected; but they require special attention at places of small depth, or when passing over bars or rocks of scanty depth of water.

Establishment of the Bay of Cadiz.

With respect to the Bay of Cadiz, 1h. 30m. may be considered the establishment on all parts of the coast. But as the tidal wave progresses through all its channels, bays, and harbors, it alters, being later at each place, so much so that while at the entrance of the Bay of Cadiz it is 1h. 24m.; in the channel of Carracas it is 2h. 30m.; at Chipiona it is 1h. 34m.; and at Bonanza it is 2h.; at the bar of Huelva it is 1h. 54m., and at its mole it is 2h.

On the coasts of Portugal and Galicia the establishment is somewhat later; for while at Cascaes it is 1h. 40m., and at Lisbon it is 2h., in the month of the Douro, at Oporto, it is 2h. 30m.; at Finistére it is 3h.; at the Sisargas it is 3h., and at Corunna 3h. 30m.

Range of the tide.

Range of the tide, is the name given to the whole rise of the tide, or the difference of level between high and low water at the time of the syzygies. The height of the level of high water is more subject to change than the establishment of the port.

In the tables above mentioned, the mean of a multitude of observations, under normal conditions at the ordinary syzygies, is called the range of the tide.

Range of tide in the Bay of Cadiz and on the coast of Portugal.

The greatest height which the tidal waters attain in the Bay of Cadiz is from twelve to thirteen feet as a mean result at ordinary springs, and fourteen to fifteen feet on the coasts of Portugal and Galicia. At equinoctial springs three to four feet must be added to that height, unless any atmospheric change takes place.

But it is very well known that the maximum height of the tide never coincides with the time of high water at the syzygies, but that it is from thirty-six to forty-eight hours later; consequently, the navigator, bound to a port having a shallow bar, must bear in mind that the highest tide will always be that corresponding to the second or third day after new or full moon.

Streams of the tide.

Certain eddies of the tidal stream appear always to take place as the consequence of the general current, continuing until they disappear entirely. This phenomenon,

constantly occurring in the Strait of Gibraltar, is scarcely perceptible at its western entrance. They are found more especially off the salient points of the coast, and with more intensity off those which project at right angles to it. Hence, off Cape Trafalgar the stream which bears its name is perpetual.

To all appearances these errant streams of tide are produced by the encounter of two opposite currents; and from what has been observed in the strait, that the strength of it increases with the tidal stream, attaining its greatest strength at half-tide, when the streams of flood and ebb are at their maximum velocity.

Cape Trafalgar Stream.

The errant stream off Cape Trafalgar is most violent, without losing strength in either tide, whether it be ordinary springs or neaps. It extends off to the S. W., beyond and passing over the Aceitera Rock, until it becomes lost in the general current.

When the swell or sea runs in the same direction as the errant stream, the waves rise so much as nearly to break, which leads to the suspicion that there are rocks in localities where they are unknown. It is advisable, therefore, for vessels to avoid them, and to keep further even from Cape Trafalgar when there is a high sea running.

Errant streams outside the strait.

Although these errant streams are common enough to the eastward of the strait, they are not to be found to the westward of it. It is natural to infer it should be so, because the general easterly current carries them into the Mediterranean until they subside; while, in the western entrance of the strait, they only begin to form themselves off Capes Trafalgar and Espartel.

Errant streams of Cape St. Vincent.

In the Gulf of Cadiz, to the west of those capes, these errant streams are unknown, and only outside Cape St. Vincent and about three miles from it, now and then one is found, which, on account of their scarcity, have been taken for rocks. But this may be entirely attributed to the shock of the general current which runs on the coast of Portugal with the stream of flood which sweeps out of the Gulf of Cadiz.

Similar threads of errant currents are formed on the coast of Galicia, which sometimes alarm navigators, as they occasion appearances as if formed by rocks. These threads may be the effect of the tidal stream as it leaves the estuaries, meeting the general current along the coast.

From tidal observations made in the Strait of Gibraltar in the years 1852 and 1853, the following establishments were determined:

West coast of Morocco.

Mogador	$1^h\ 18^m$
Rabat	$1^h\ 46^m$

West coast of Spain.

Chipiona	$1^h\ 30^m$
Rota	$1^h\ 24^m$
Cadiz	$1^h\ 23^m$
Conil	$1^h\ 18^m$

Strait of Gibraltar.

Cape Plata	$1^h\ 45^m$
Tarifa	$1^h\ 46^m$
Gibraltar	$1^h\ 47^m$
Algeciras	$1^h\ 49^m$
Ceuta	$2^h\ 6^m$
Tangier	$2^h\ 13^m$

Northern coast of Morocco.

Tetuan	$2^h\ 23^m$

Tides.

The tidal wave from the ocean would arrive simultaneously at Mogador and Conil; it then continues on into the Strait of Gibraltar, producing high water at nearly the same time along the coast between Cape Plata and Europa Point. It is not until about twenty minutes after it has reached its highest level on the coast of Spain that the water is at its highest level on the opposite coast of Africa.

Referring to the establishments at Toulon, Algiers, and Cagliari, it will be seen that the hours of the establishments of the ports of Spain in the Strait of Gibraltar differ from them about six hours, and therefore it is low water in the strait when it is high in the Mediterranean ports mentioned, and, according to the ordinary mode of reasoning, the flood will be running in the strait while it is ebb at Toulon, Algiers, and Cagliari, and *vice versa.*

Observations are yet wanting to determine whether high water is made at Toulon, for example, by the same wave

which makes low water at the same time at Gibraltar. In this case, the hours of the establishments of the ports of Spain in the Mediterranean should be comprised between those of the establishments of Gibraltar and Toulon. At all events, whether the space between Gibraltar and Toulon is visited by one or more undulations, the same result would follow.

Tidal currents. It is known that the tidal wave, on approaching a coast, occasions regular and periodical currents, lasting, as the tides, about six hours, and running generally in an opposite direction to them. Whatever cause may be advanced to explain these currents, whether they are attributed to the difference of level between high and low water, to the undulation of the tidal wave, or to any other cause, it is known that generally in closed bays the water enters until it is high water at the head of the bay, and the ebb lasts until it is low there. Were the western division of the Mediterranean, limited by Sardinia and Corsica, considered as a closed bay, the waters would run from the Atlantic to the Mediterranean while the tide rose at Cagliari, for example, and would run out of the Mediterranean while the tide was falling at the same port. Such, in fact, appears to be the law which governs the tides in the Strait of Gibraltar.

By the stream of flood and stream of ebb is generally meant the movement of the waters at the moment when the sea rises or falls. This appellation is erroneous, unless the port is named to which the ebb and flow alludes. It results. in fact, that if the tide which is established in the Strait of Gibraltar at the moment when the waters enter the Mediterranean to make high water at Cagliari, be called the flood tide, this stream of flood for Cagliari will be the stream of ebb for Gibraltar, and *vice versa.* This would appear to be the explanation of the anomaly noticed by mariners, who have observed that, in the Strait of Gibraltar, the stream of flood, that which is established when the sea rises on the shore, runs to the W., while that of the ebb runs to the E.

We will preserve here, in special reference to the Strait of Gibraltar, the appellations *stream of flood* and *stream of ebb* to designate the movement of the waters when they rise or fall in the ports of the strait. But it should not be lost sight of that what we here call the *stream of flood* will really be the stream of ebb for the Mediterranean, and what

we call the *stream of ebb* will be the stream of flood for the Mediterranean.

There is little to say on the rise of the tides in the different ports where observations on the tides have been made. In proportion as the undulation advances toward the Mediterranean, the difference between the high and low water diminishes rapidly. In the following table is given the rise and fall at spring and neap tides, with the number of days of observation on which these calculations have been based:

Places.	Hours of establishment.	Springs, rise.	Neaps, range.	Number of days of observations.
	H. M.	*Feet.*	*Feet.*	
Chipiona	1 30	12.5	3.6	58
Rota	1 24	12.6	3.6	39
Cadiz	1 23	12.9	3.6	26
Conil	1 18	11.8	3.3	12
Cape Plata	1 45	8.0	2.6	50
Tarifa	1 46	5.9	1.3	73
Algeciras	1 49	3.9	1.3	30
Gibraltar	1 47	4.1	1.3	157
Mogador	1 18	12.4	3.6	8
Rabat	1 46	11.0	3.3	9
Tangier	2 13	8.3	2.0	76
Ceuta	2 06	3.7	1.3	76
Tetuan	2 23	2.3	0.5	3

Currents, Strait of Gibraltar.

Surface currents only will be considered, as these only concern the navigator, and the law by which they are regulated is subject to many changes.

Most frequently a strong wind prevails in the strait, lasting, perhaps, for months, and exerting a considerable influence on the surface of the water. Observations establish this influence, as shown by perturbations in the rise and fall of the tide, which have been entirely produced by the existing wind; the effect which this must have on the currents is evident.

Permanent currents.

The currents of the Strait of Gibraltar are of two kinds: the one is permanent and its direction constant. It runs from W. to E., transferring to the Mediterranean the waters of the Atlantic, which it would probably do at a constant rate, were it not for the effect of the winds prevailing off the coast. The other proceeds from the tides; they vary in

strength according to the age of the moon: that is, according to the force of the tide. They are periodical, as the tides by which they are produced. With the rising tide the stream sets to the W., bringing the waters of the Mediterranean into the Atlantic; and with the ebb the tidal stream sets E. from the Atlantic to the Mediterranean. These currents exert their influence over the whole surface of the strait.

While the tide is falling the ebb stream runs in the same direction as the permanent current, with their united strength, and the water through the whole extent of the strait is carried from the Atlantic toward the Mediterranean. On the rising tide the current of the flood sets to the W. in a direction diametrically opposite to that of the permanent currents. Then, if the velocity of the current of the flood is inferior to that of the permanent current, the waters continue to flow to the eastward; if it is equal there is no current; and if it is superior the waters flow to the westward. In any case, the currents to the westward, in the Strait of Gibraltar, will only last a tide, and their velocity will always be less than that of the currents setting to the eastward.

These principal facts well established, the action of the general currents of the strait may be explained from its form and the direction of its shores.

We will divide the Strait of Gibraltar into three parts: the first, the most western, including from Cape Trafalgar to Tarifa, and from Point Cires to Cape Spartel, on the opposite coast.

The second, from Tarifa to Point Frayle, on the coast of Spain, and from Point Cires to Point Leona, on the African coast.

The third, and eastern, will extend from Point Frayle to Europa Point, and from Point Leona to Ceuta.

We will consider the shores of the strait as divested of their sinuosities. In the several bays there are eddies produced by the general currents of the strait, and the law which they follow depends on the formation of the coast and the direction of the main stream.

Considering the first part and joining by a straight line Cape Trafalgar and Tarifa on the one side, and Point Cires and Spartel on the other, we have the form of an irregular quadrilateral—a kind of funnel, on which the western opening is about three times larger than the eastern; the

northern side runs N. W. and S. E, while the southern takes a direction nearly approaching E. and W.

The second division is different: it is a quadrilateral, the two openings of which are nearly equal; its breadth is nearly uniform, and the indentations on its borders have but little depth.

In the third division the eastern mouth is much larger than the western; besides, it has the deep bay of Algeciras on the north, and that of Ceuta on the south.

By examining what should be the action of a permanent current coming from the W., it will be easily perceived that the waters, in penetrating the first division, should accelerate their velocity in proportion as the space through which they run becomes narrower; thence this current should increase its velocity as it approaches the meridian of Tarifa; its greatest velocity will be in the second division, and it will diminish its rate on entering the third division. Moreover, the current will be more rapid at the center than on the shores of the strait. Near the shores, in fact, the waters on meeting any obstacle opposed by the land, lose a portion of their force and are bent out of their ordinary course. While the waters on the coast of Africa, owing to the contour of the shore, will continue to run toward the E., those on the coast of Spain will be directed toward the S. E.

In the vicinity of Tarifa and to the westward of the peninsula of this name, the mass of waters is driven back by the coast, the direction of which is nearly S., toward the coast of Africa; there it flows again to the eastward. From this it results that in the second division the current is particularly rapid near the coast of Africa.

On entering the third division the space over which the waters spread increases principally toward the N., so that there, also, the current is found to be more rapid on the coast of Africa than on that of Europe.

Thus, then, it appears that the permanent current coming from the W., weak at first between Trafalgar and Spartel, more rapid, however, in the middle than upon its borders, increases in velocity as it approaches the meridian of Tarifa. On the coast of Spain the waters incline toward the S. E.; on the coast of Africa they have a tendency toward the N. E. In the center their direction is E., and near the peninsula of Tarifa and Point Cires they attain their greatest velocity. Near Tarifa they are directed to the S. E. toward

the African coast; at Point Cires they run to the E. N. E. The mass of waters under this combined action traverses the second division parallel to the coast of Africa: that is, from W. to E., the most rapid current approaching nearer to the African than to the Spanish shore. The same is the case in the third division, where the waters enter the Mediterranean in continuing their route parallel to the coast of Africa, and to the N. extend toward the bay of Algeciras and Europa Point.

Introducing the tidal streams, it is sufficient to recall that the current of the ebb having the same direction as the permanent currents, their combined velocities continue to follow the direction already given.

As to the current of the flood, its velocity varying with the strength of the tides and its direction being diametrically opposite to that of the permanent current, its effect will depend especially on the age of the moon, or rather on the strength of the tidal stream produced by it. It is remarked that, on the edges of the strait, where, as already stated, the permanent current is little or nothing, each return of the tide brings a change of direction in the movement of the waters. Always when the tide rises the waters near the shore run to the W., while they run to the eastward as the tide falls; but in proportion as the distance is increased from the shore the currents to the W. diminish, and according to the division and the strength of the tide there is a line, more or less removed from the shore, on which the current is nothing, and which separates the central part of the strait, where the waters continue to run to the E., from that nearer the coast, where the tidal stream is felt. This line changes every day as its distance from the shore varies with the strength of the tidal stream.

The turning of the tidal stream.

It has been found from observation that over the whole extent of the strait, near the salient points, such as Europa Point, Tarifa, Trafalgar, on the coast of Spain; Spartel, Cires, and Leona, on the coast of Africa, the stream of tide turns at the moment of slack water. As soon as the tide begins to rise the stream commences to run to the westward, and as soon as it begins to fall it commences running to the eastward. But at a distance from the shore, according to the opinion of pilots, the change of the stream precedes that of the tide by about three-quarters of an hour on the coast of Spain, and consequently about an hour on the coast of

Africa, since the times of high water on this coast are later by twenty minutes than those on the coast of Spain. Thus, at the moment of slack water at Tarifa, for instance, the westerly stream should have ceased off shore and given place to the easterly stream for about three-quarters of an hour.

Although it may be easy to determine at each returning tide the stream to the W. on the borders of the strait, it is not so off shore. It results from the foregoing, that, according to the division of the strait, the permanent current to the E. having a greater velocity, it may be that the stream of the flood has not sufficient velocity to stem it, and then the waters continue to run toward the Mediterranean, but with diminished velocity. After numerous observations it would appear that toward the western part of the third division even the weaker tides produce light currents to the westward. In the eastern part of the third division and in the center of the first, the stream of the flood is not sensible except at the epoch of the syzygies. Finally, in the second division, which is the narrowest, as also in the eastern part of the first division, it is only at the times of the highest equinoctial tides that currents to the westward can be expected, and then always very weak. During a period of sixteen months this current was found but once, which would seem to prove that these westerly currents are due solely to the combined action of a favorable wind with the spring tide. As to the distance from shore at which the stream of the flood is felt, it is easy to conclude that the greatest distance will be in the first division, and that in the second and near the salient points which limit the third, this distance will be very small.

These generalities established, we will follow the movement of the waters through the extent of the strait. During the rising tide the flood enters the strait and becomes sensible at Europa Point and at Ceuta the moment when the waters commence to rise. Too weak, in general, to stem the current from the eastward, it is felt at some cables' lengths only from Europa Point, and from the northeast point of the Peninsula of Ceuta. Off this last point the waters run directly towards Point Leona. At Europa Point the stream runs to the S. W., and is much more rapid there than on the African coast. It is directed toward Point Carnero, throwing, in part, its waters into the Bay of Algeciras, of which we shall speak hereafter. There meeting the easterly

current, the tidal stream inclines more to the S. After traversing the Bay of Algeciras, the stream of the flood follows the coast of Spain as far as Tarifa. From Tarifa it continues toward the W., spreading more and more from the shore, and following the trend of the coast as far as Cadiz. On the coast of Africa the stream of the flood is experienced in the same manner, first from Ceuta to Point Cires, but only a very short distance from the shore. From Point Cires to Spartel the waters go to the westward with the flood, the action of which extends over a continually increasing space. Arriving at the western part of the strait the waters follow the coasts, one part flowing northward toward Cadiz, while the other runs to the S. along the coast of Africa.

Such is the general direction of the flood. Nevertheless, it is important that navigators should know that through the whole extent of the strait, it is principally on the coast of Spain that the widest extent of the stream of the flood is felt. In the first division of the strait the African coast presents nearly the same advantages; but in the second division, and equally in the third, the stream to the W. is more rapid, and is felt more off shore on the coast of Spain than on that of Africa.

Eddies and counter-currents

Eddies and counter-currents, so numerous in the Strait of Gibraltar, are produced in the bays and indentations of the coast by the outside currents meeting the salient points of the shore. In general, whenever a current, outside of a bay, traverses its entrance obliquely, the stream striking the extreme point of this bay produces counter-currents, which extend along the shore in an opposite direction to that of the outside current.

Counter-current, Bay of Tangier.

In the Bay of Tangier with the ebb, the stream strikes against Malabata Point; a part is turned to the southward and forms a current along the whole shore of the bay in a direction opposite to that of the outside current. Observations show that this effect, which is produced in all moderately deep bays, produces counter-currents as periodical and regular as those produced by the tide. Only this reversal of the stream does not take place, as that of the outside current, at the moment of slack water, but three hours after the commencement of the outer current. Thus it would not be until the tide has ebbed three hours at Tangier, that the counter-current runs to the westward, and not

until three hours after the rise that it runs to the eastward.

Al-Boassa and Cires.

In the bays these counter-currents are always produced if the outer current is sufficiently rapid. In the bay between Al-Boassa and Cires, the ebb, which is very rapid at the latter point, produces a counter-current, while the flood, comparatively weak, and meeting a less salient point at Al-Boassa, does not form a counter-current. In this case, as at Cala Grande, the stream on coming in contact with the land between Point Alcazar and Point Cires, establishes during the ebb a counter-current to the westward along the shore between Alcazar and Al-Boassa. With the flood stream all the waters run toward the W., following the shore, from which it results that the Bay of Cala Grande has this great advantage, that near the shore the stream runs continually to the westward. This fact is of great importance to sailing vessels passing the strait from E. to W. with head-winds.

To the east of Tarifa.

To the east of Tarifa it is much the same. There, in fact, the stream of flood has never sufficient force to produce a counter-current running in the opposite direction, while with the ebb the current running to the S. E. produces to the eastward of the peninsula an eddy or counter-current from E. to W., along the coast, the effect of which is sometimes felt far to the eastward of the peninsula.

In the bay north of Ceuta the counter-currents are much the same as in Tangier Bay, but extremely weak. The counter-currents in the Bays of Babate, Bolonia, Val de Vaqueros, and the anchorage of Los Lances, are sufficiently explained by what has been already said.

Bay of Gibraltar.

In the great Bay of Gibraltar there are peculiar counter-currents. On the flood-tide the stream enters the strait by Europa Point and sets toward Point Carnero, off which it divides into two branches; the one continues its course to the westward, the other runs along the western shore of the bay, making a northerly current from Carnero to Algeciras. As the flood passes Europa Point, a portion of the stream turns to the N. and runs along the shore to the head of the bay, where, meeting that of the western shore, by their combined action, the stream is directed from N. to S. in the center of the bay, and goes to mix with the flood stream in the strait. Thus, during the flood there are actually three currents in the Bay of Gibraltar, two running to the N. along either shore, which, uniting at the head of the bay,

form a current running from N. to S. in the middle of it. The stream on the western is much stronger than that on the eastern side of the bay. The western counter-current forms at Point Carnero as soon as the flood makes there; an hour afterward it is felt at Getares, and it does not arrive at Algeciras until two hours after slack water. The eastern stream is not felt at the anchorage at Gibraltar until three hours after the making of the flood; the consequence of which is, that here the current produced by the flood is of shorter duration than that formed by the ebb, and its velocity is never as great.

When the ebb commences in the strait, the stream enters the bay at Point Carnero and runs to the N. E. across the bay. At the head of the bay it divides, one part following the shore toward Gibraltar, the other toward Algeciras, forming a current from N. to S. along the whole western shore of the bay. Thus, during the ebb, as on the flood, there are three currents in the Bay of Gibraltar. These streams are periodical, changing regularly with every tide, and about two or three hours after high or low water. It has been observed that these particular currents, due to eddies from the general stream, are subject to great variation, not only from the winds, but their intensity and limits vary much with the strength of the tidal stream. Off Carnero Point the tide runs nearly always toward the N. E. or the N. W., and consequently sets generally toward the shore. Carnero, or rather Acebuche, to the west of it, is one of the most difficult points for vessels to pass from the eastward; besides which, Point Carnero is one of the most dangerous in the strait, and the greater number of accidents occur at this point, owing, principally, to the currents above mentioned.

Velocity of the currents in the strait.

The velocity of the currents in the strait varies more than their direction; it is, besides, extremely difficult to explain them. The most rapid currents measured have been 5.2 miles per hour in the middle of the strait to the northward of Point Alcazar; at about four miles from the African coast their direction was from W. to E. Currents from four to five miles per hour have also been measured to the westward of Tarifa but a short distance from the land, and running to the S. E. Near Point Cires and Leona they have been found from three to four miles per hour. These exceptional

velocities were obtained on the full strength of the ebb at the period of the spring tides.

Near Tarifa, a cable's length to the south of the point of the peninsula, at the full moon, currents were measured on the strength of the ebb, running to the S. E. at the rate of four miles, while those occasioned by the flood were a little less than three miles. In the same place the neap ebb gave a rate of two miles, and the flood but 1.4 miles.

It is difficult to ascertain the velocity of the permanent current. To do so it would be necessary to anchor in the middle of the strait, and remain there some time. From the numerous observations made on board the *Phare*, the result would appear to be that the velocity of the permanent current is about one mile per hour near Point Tarifa, and a little more than 2.5 miles in the middle and narrowest part of the strait. Near the coasts and in the bays, the currents observed have never exceeded 1.5 miles. Generally, their velocity does not reach one mile per hour, and the flood is weaker than the ebb.

The alternate streams of flood and ebb are felt near the shore along all the coast of Spain between Cadiz and Trafalgar, the flood running toward the N., parallel to the coast, and the ebb toward the S. These currents commence to gain considerable velocity near Cape Roche. Generally, they change as the tides; that is, as soon as the tide rises the flood stream is established, and the same with the ebb as soon as it falls, and both attain their maximum velocity at half tide. However, it has been often observed on this coast, as in the Strait of Gibraltar, that the greatest velocity of the stream, whether of the flood or the ebb, coincides with the first hour of the rise and fall. Thus the currents in the middle of the strait turn about an hour before slack water, and before the change of the currents upon the coast, consequently it is often precisely at the moment of high water that the strongest currents from W. to E. are found in the middle of the strait.

The waters of the strait are generally under the influence of a current. The slacking or turning of the currents never takes place by a sudden change of direction preceded by a short period of rest. Most frequently the stream of ebb, setting toward the E., for example, inclines little by little toward the S. at the end of the tide, and is then directed to the S. W. with the commencement of the flood, to run to the

W. about two hours after the commencement of the rise. But this rule is by no means general. Sometimes the change takes place by the N., and it has been observed at the same point that the stream changes sometimes to the N., sometimes to the S., according to the caprice of the waters. The same has been observed when the ebb is about to succeed the flood. The time taken by these currents to pass from one direction to the other is as variable as their duration.

What has been said regarding the currents established at the moment of the changes of the tidal streams in the strait, applies equally to that portion of the coast of Spain, from Cadiz to Trafalgar, where observations were made by the *Phare*, only it was observed that the cessation of the tidal streams was longer, and the turning of the stream is more extended. Thus, for example, if the stream is E. at half ebb, it will be S. E. at three-quarters ebb, and S. at the moment of low water; it will then be directed to the S. W. for one or two hours before it runs W., which will be the strong flood.

Tide-races.

There are few localities where tide-races are more numerous than in the Strait of Gibraltar. They are generally produced near all the salient points where the direction of the coast changes suddenly, and near the banks in their vicinity. They form suddenly, without indication, the sea boils as water heated to evaporation, the wave is short, irregular, and very hollow, and usually breaks. These races are dangerous, not only for boats, but even for small vessels; the wind of course contributes to their formation and increases their violence.

The most violent tide-races observed in the Strait of Gibraltar are always formed near points where the angle is acute, and off which the water is not so deep. Generally the tide-races form at the time of half tide, when the stream is strongest.

In some localities the stream of the flood, as also that of the ebb, produces these races; in others they only take place with the ebb. The points on the coast of Spain where races are found are: Cape Trafalgar, the Cabezos Shoals, the south point of Tarifa, Frayle Point, Pearl Rock, and Europa Point. On the African coast—Cape Spartel, Points Malabata, Altares, Al-Boassa, Cires, Leona, and the north-west point of Ceuta.

The most violent race observed is off Cape Trafalgar, and

it forms there on each half-tide of both flood and ebb. It extends a considerable distance off the Cape in a W. S. W. direction, which is that of Meca Tower on with Trafalgar, crossing the bank of Aceitera; it extends over all the small banks of the Phare. This race, which from its extent and violence is distinguished from all others of the strait, most probably arises from the sudden change of the direction of the coast, and the number of banks in its vicinity. At every half-tide a race and eddies are also formed on the Cabezos or near them, varying both in their extent and direction. They often extend off shore, following the edges of the bank of shoal water. Though less violent than races near the points, they get up an agitation in smooth weather, and with a heavy sea and bad weather they extend the whole width of the strait, from the Cabezos to the bank between the Points Malabata and Al-Boassa, on the coast of Africa. This direction is that of the least water in the strait, and pilots give it the name of the *race of Bajas.*

The race off Tarifa Point is comparatively of small extent. With the ebb it is directed to the S. E., with the flood to S. W., and is produced at each half-tide, that occasioned by the ebb being more considerable than that on the flood.

The races at Points Frayle and Europa resemble those just mentioned; the first that of the Cabezos, the latter that off Tarifa. They only differ from being less extended and less violent.

On the coast of Africa there is a tide-race off Cape Spartel, at Point Indios, and also at Point Casbah, at the entrance of the Bay of Tangier. They are produced by both the flood and the ebb, but are generally of small extent and of little importance.

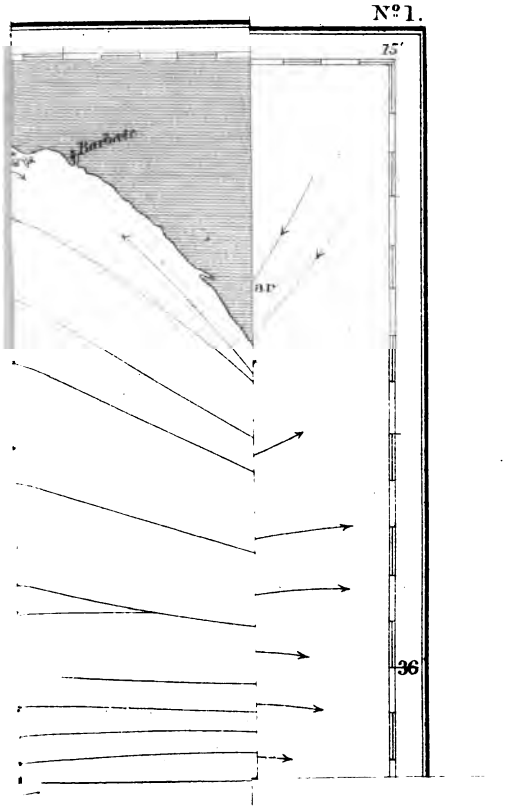
Between Points Malabata and Al-Boassa, on the Almirante, Phœnix and Jaseur Banks, are the strongest tide-races on the African coast. They are produced with the flood and the ebb, and often extend across the straits as above mentioned, to the Cabezos.

The races off Points Cires, Leona, &c., as far as Ceuta, are of little extent. They are sometimes violent, as the tide which produces them; they are only met there at half-ebb. The flood sometimes produces a race, but of no importance.

In fact, in the strait and principally to the northward of Tangier, there are found eddies and currents which are produced irregularly at the periods of the spring tides. They

are of short duration, of small extent, and continual shifting.

To render more clear the tidal streams in the Strait of Gibraltar, the charts deduced from the observations taken on board the *Phare* are attached. They show the movement of the waters during the first and last three hours of the flood and ebb, as also the counter-currents which are produced in the bays.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75'
Barbate
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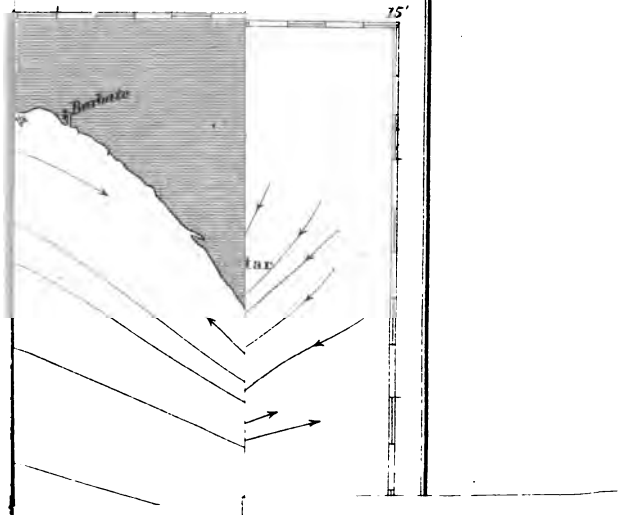

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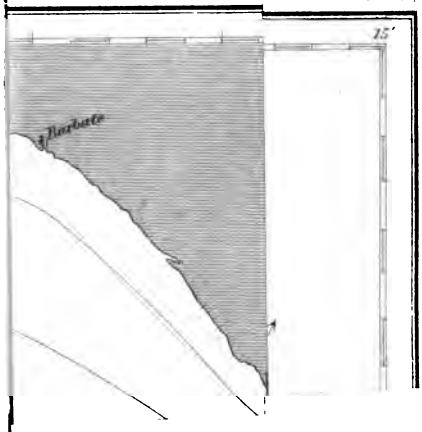

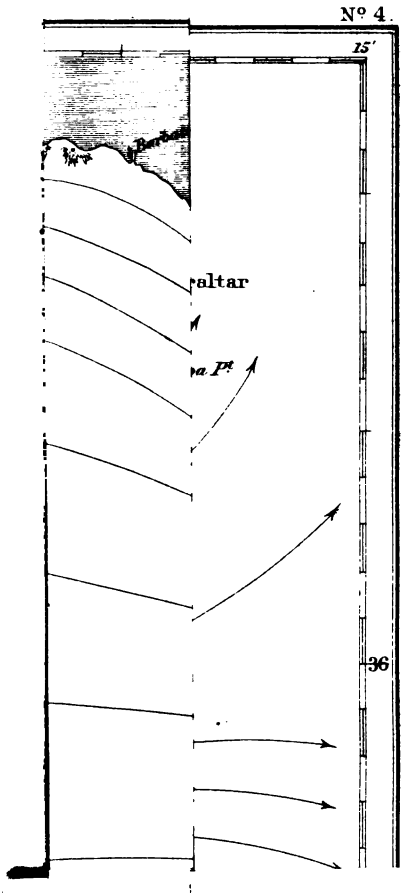

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CHAPTER III.

NAVIGATION OF THE GULF OF CADIZ, THE WESTERN SHORE OF THE SPANISH PENINSULA AND THE STRAIT OF GIBRALTAR.

Coast of the Gulf of Cadiz.

The coasts of this gulf are generally low and uniform, excepting those in the vicinity of the strait and about Cape St. Vincent. Besides, much of the coast about Cadiz is fringed with outlying and dangerous reefs, from which it would not be easy for vessels to extricate themselves if they had not that port to run for. Fortunately the whole shore of the gulf is lined with a bank of soundings, which, on the coast of Spain and Portugal, taking the one-hundred-fathom line, extends fifteen to twenty miles from the shore, and from the African shore to nearly the same distance, thus giving ample warning to the navigator, by the lighter color of the water, of his proximity to the shore, should he not be able to distinguish this on account of its distance and the state of the weather.

Landfalls.

On these coasts there are three very remarkable points for a landfall, and these are Cape Spartel, Cape St. Vincent, and to the northward, Cape Villano or Finistère. The first is always used by vessels bound to the Mediterranean and those coming from America, which run on some parallel southward of latitude 36°, on account of the northerly winds not allowing them to make Cape St. Vincent. The same landfall is made generally by other vessels from the westward, which have had to make northing whether bound to Cadiz or the Mediterranean, and those also from European ports to the northward make Cape Villano, whether they may be bound to any of the estuaries or ports of Galicia and Portugal, or to Cadiz, or the Mediterranean.

Vessels bound to the Mediterranean and running on the parallel of the strait, should always make Cape Spartel their landfall; in preference to Cape Trafalgar. Cape Spartel is high, bold, and conspicuous; Cape Trafalgar is low and surrounded by reefs, and when the vessel's position has not been confirmed by known points of the land,

the landfall which should be adopted ought always to be conspicuous and bold, one that may be seen from a great distance and also by night, and better if it should have a light and can be approached without any risk.

Cape Trafalgar may be made by vessels bound to the Mediterranean that have already confirmed their position by seeing Cape St. Vincent, Cape St. Mary, &c., and with N. E. winds, because it is then probable that the levanter will be blowing violently in the strait, and it is better that they should then keep the Spanish coast on board.

Cape St. Vincent is generally preferred as a landfall on account of its conspicuous nature, as well as its freedom from rocks, and its projecting outside the line of coast, which allows of vessels making it without being hampered by the shore north and south of it. Besides which it is admirably marked by the height of Monchique, which can be seen at a great distance; but in time of war it has been avoided as a landfall because it has been infested by privateers and ships of the enemy.

Cape Villano is always preferable as a landfall to Cape Finistère, because it is high and projects out to the N. W., and therefore is always adopted by vessels from the English or St. George's Channels. These, indeed, generally avoid making Cape Prior, that they may keep clear of the currents, heavy seas and winds common to the northwest face of the peninsula. Villano is easy to make, not only on account of its advanced position outside of this coast, but also from its peculiar form. When made from afar it has the appearance of an old castle, the effect of a peak on its summit; and when seen isolated it assumes the appearance of a vessel rigged as a sloop or cutter. It is seen before Cape Tourinana, because it is higher and more remarkable, although it does not project so much.

The Cies Islands and Cape La Roca.

Vessels from the westward bound to Lisbon or Vigo and confident of their reckoning, have the Cies Islands and Cape La Roca as landfalls, both of which are easily made. Vessels bound to Oporto should be careful of the shore unless certain of their reckoning, for this port being situated on ground of much sameness and uniformity, it is not easy to recognize afar off, when the coast is not very clear or its configuration distinct.

All the points we have mentioned being well suited for a landfall, are happily provided with excellent lights, which en-

able a vessel to approach them without risk by night. The light, however, recently established on Cape Spartel, has been the cause of a remarkable mistake. Three vessels coming from the westward made that cape by night, their commanders being ignorant of a light having been placed there, mistook it for Tarifa,* which has also a fixed white light, and they were consequently embayed and lost in Jeremias Bay, no doubt considering that bay to be the mouth of the strait; two of these were English and one French. The light was established on the 15th of October, 1864.

Making Cadiz.

A ship bound to Cadiz from America, unable to make Cape St. Vincent, if her reckoning be good, might make the land somewhere of the bay. The elevated heights of San Cristoval and Ubrique, visible from a great distance in clear weather, are excellent marks for it. San Cristoval, known to navigators under the name of *Cabeza del Moro*, is 5,758 feet high, and may be seen from a vessel twenty-five to thirty miles from the bay. Neither of these heights can possibly be mistaken for any other, because they only are to be then seen above the horizon.

Coming from the Canaries a vessel may lookout for Cadiz if her reckoning be good and she has favorable winds; but if these be to the southward of E., and an easterly wind be observed in the strait, she ought to make for Cape Spartel, and get a fresh departure so as to make sure of Cadiz Bay; and should this be at night, the lights of Cape Spartel and Trafalgar will be still more certain means of giving the position and the proper course to be steered.

Making Cadiz in hazy weather.

It might happen that a vessel has hazy weather for making Cadiz, and yet she might clearly see the Height of Beba and that of San Lucar not far from it. The first is a hill of gentle slope rising above the adjacent land, and is distinguished by a white house called Beba or Breba, situated three miles S. 62° E. of Chipiona, and is seen from the whole neighborhood of Cadiz. A vessel a little north of its parallel would soon make out the ex-convent of Ragla, the town of Chipiona, and other buildings on the coast, the whiteness of which would render them visible in spite of the haze, should there be any.

If the hill should be so enveloped in haze that neither the small heights nor the buildings of the coast can be seen, the color of the water near the shore will indicate its proximity, and the lead will soon verify the position. At a distance of

* Tarifa light has recently been altered to a red light.

twelve or fifteen miles from Cadiz, when from W. S. W. to S. of it, the soundings are clear sand, and if it be loose blackish clay the vessel will be on the parallel of the bay.

Vessels from the Strait of Gibraltar bound to Cadiz should keep the Spanish coast, and may pass inside of the Aceitera Rock, and even the Conil Reefs if she have on board a pilot for their channels, and the vessel should be of proper draught. The steamers which trade along the coast can, and do, adopt this navigation; for, without losing any distance, they are sheltered from the wind, which about here blows with considerable violence.

The navigator, however, who has not sufficient experience, should keep outside of all these dangers, especially if his vessel is large and has only sail. In such case it will be sufficient to keep at four miles from the coast, and, bringing Cadiz light N. by E., steer to the northward, to have the tower on the starboard hand, and pass as near as safe to the reefs off Point San Sebastian, so as to take advantage as much as possible of the wind on first standing into the bay.

Making Cadiz with an E. wind.

Should the tide not answer, or if it be evident that on gaining San Sebastian Point the ebb will have made, (which is a point that should be studied beforehand,) the navigator must be contented to stand off and on between Cadiz and Cape Roche, where the wind will not be so strong as in the entrance of the bay; and as soon as he has reason to believe that the tide is making at Cadiz, he may run for the entrance of the bay with the view of taking the harbor.

He should endeavor always so to manage his boards as to be at the entrance of the channel by the time the flood has gained its greatest strength, with the view of making the least possible number of boards. It would not be prudent to beat in against a head-wind on an ebb tide unless at neaps, and even then not unless the vessel be a fast sailer.

If, on making Cape Trafalgar, there is much ground swell, a vessel should not attempt to pass inside of the Aceitera and other dangers; she should rather increase her distance to five miles from the coast, as much for avoiding the streams of current off the cape as for keeping in depths of fifteen to eighteen fathoms; and when she has gained the meridian of Cadiz light she should steer so as to keep in depths in which the sea will not break, and edge as near as

she can with safety to the reefs of San Sebastian, so as to gain as much as possible on her first reach into the bay.

Precautions on passing inside Conil Rock.

A vessel after having adopted the passage inside the reefs might desire to get outside of them, which she might do by passing between the Meca and Conil Reefs, or between these and Cape Roche, taking care to determine her position well by good cross-bearings, so as to be able to select the proper course to take her mid-channel, and bearing in mind that the flood tide *always sets to the N. W.*

If the ground swell is very heavy it will break on nearly all the rocks, and will run high in the channels; in such a case the navigator must not think of adopting the inner route.

When bound to Cadiz from the strait, and the ship is on the meridian of Cape Plata, an easterly wind will slacken, and it may be observed if the westerly wind is blowing at sea. The vessel must then keep on a southern parallel so as to be able to pass from ten to twelve miles from Cape Trafalgar, with the view that, when the *westerly* wind reaches her, she may be able to stand on to the entrance of the bay.

Precautions in passing the strait, bound to Cadiz.

In winter-time the same precaution must be observed coming from the strait, but from another motive; since it frequently happens that, while there is a fresh easterly wind in the mouth of the strait, the vendaval will be prevailing to the westward. Hence the navigator, on gaining the meridian of Tarifa, finding the easterly wind veering to the S. E., should keep toward the African shore; for he may be sure that, as he reaches Cape Spartel, the wind will draw to the southward and get steady at S. W.; then being well clear of the Spanish coast, he will easily clear all the reefs and run free for Cadiz Bay.

Precautions for San Lucar or Huelva.

The same course should be observed, and the same precaution followed, by vessels bound to San Lucar or Huelva; that is, with easterly wind prevailing, they should keep in hand the Spanish coast whether they pass inside or outside of the shoals or reefs.

From Cadiz to the strait in an easterly wind.

Vessels from Cadiz or any of the western ports bound to the strait with an easterly wind, should hug the shore as much as possible; in doing which they will find shelter from the sea. Thus they may easily get as far as Cape de Plata, from which they might stand out and work to the eastward, should there not be much sea. By this

means they will profit by all the currents setting them to windward.

If, on arriving off Cape Trafalgar, there is observed to be too much wind in the strait to admit of working against it, it will be better to cross the entrance with the wind free, and seek refuge under Cape Spartel. It is of no consequence anchoring five or six miles to leeward of this cape, as it soon can be made up; when the vessel is sheltered from the sea, Jeremias Bay may be gained, where she may wait until the easterly wind is blown over.

From Cadiz to to the strait with a westerly wind.

From Cadiz or ports west of it, there is no difficulty in getting to the strait with a westerly wind. As westerly winds are favorable for crossing it, it is sufficient, as soon as a vessel is clear of the reefs of San Sebastian, if on leaving Cadiz she run to the southward until she finds herself S. W. of Conil, to lay her head S. E. for the middle of the strait.

If there should be much ground sea, on leaving Cadiz she might steer S. by W. or S. S. W., so as to pass clear of the shoals on the coast, and afterwards lay her head S., S. S. E., and in proportion as she draws into the strait.

By night.

Whichever navigation is adopted by night the lights of San Sebastian, Trafalgar, and Spartel will give the navigator his position so well as to enable him to shape his proper course. In fact, the navigation of the strait by night may be made with the utmost facility. Cross-bearings of the lights of Point Europa and Acho, of Ceuta and Tarifa, with those of Spartel and Trafalgar, and on the coast with that of Cadiz, will always give the navigator his position, and with these he may navigate from the strait to Cadiz, and *vice versa.* The character of the lights on the coast of Spain are so arranged that they cannot be mistaken for each other, and their particulars are to be found in the usual books.

If a vessel from Cadiz be coming from the westward, and she encounter a strong levanter off Cape St. Mary, she should work to windward between the parallel of Cadiz and the coast of Huelva, so as to avoid the strong wind on the parallel of the strait, as well as the sea which it raises; and she had better keep to the coast from the moment she can lay up for the Broa de San Lucar.

Coasting vessels working from Agnamonte or Huelva to Cadiz, and from Cadiz to the strait, often anchor when they meet an easterly wind. They will lie at anchor off some

beach during the height of the wind, and avail themselves of the nights when, besides not being so strong, the wind becomes more N. E. The ebb tide should be profited by as much as possible, for at springs it helps a vessel to windward very much.

From Cadiz with the vendaval.

The greatest difficulty a vessel has to overcome, whether from the westward or from the strait, is when she has to deal with a vendaval in rainy weather, which prevents anything from being seen of land or sea. If the commander should not have previously obtained his position, and thus be ready with the course for running into the bay, it would be better for him to haul out, than to get entangled with the coast, and keep, if he can, on the parallel of the strait, in order that, in case of mischief, he can run for it.

If caught on the meridian of Huelva or Agnamonte, he should endeavor to wait, under all possible sail, in order to make up for the current, which, along with the tide, will set into the Gulf of Huelva, and he should make such boards as will best avoid this danger until the weather clears and enables him to make the land and obtain the position.

As the coast in the vicinity of Cadiz and the whole circuit of the Gulf of Huelva is low, it cannot be seen from a vessel until she is close to it. In this case recourse may be had to the lead, and her distance from it determined by the depth of water and the character of the bottom. The depth of a hundred fathoms off Cadiz and the Gulf of Huelva is more than twenty miles from the shore.

From the strait with a S.W. wind.

On crossing from the strait to Cadiz with a fresh S. W. wind, a vessel must be careful to make such courses as will free her from the effect of the current, which will drift her toward Conil and Santipetri. Similar precaution should be taken by those which are running for Cape St. Vincent with the same wind and weather, to avoid being set down towards San Lucar and Huelva, and also those again which are taking the opposite direction.

The steam packets which frequent the coast know from experience that it is essential to keep well clear of the coast on crossing the Gulf of Cadiz when blowing strong from seaward, so as to avoid being set down toward it, whether off Cape St. Mary, the Arenas Gordas, Chipiona, or the Conil Reefs. With foul winds, or even those from N. to E., on the contrary, they close with the shore, for the currents *then* set from it.

From the strait to the Portuguese and Galicia coast.

Vessels from Cadiz or the Strait of Gibraltar bound to the coast of Portugal or Galicia will make their passages as we have already shown in each particular case, making for Cape St. Vincent with the view of doubling it at a convenient distance. And this cape being clear, it may be approached at pleasure.

If vessels near it with a fresh S. W. breeze, they should give it a good berth; and if bound to Vigo, the Bay of Biscay, or the Channel, they should take care to make a more westerly course than is required by the trend of the coast, because the current produced by this wind sets a vessel toward the shore. It must also be remembered that the vendaval obscures the land, and by running too close a vessel may find herself aground when she is considered clear of all danger.

Should the vessel be bound to Lisbon, Capes Espichel and La Roca will be seen during the day, and their lights at night, to show the position of the estuary; but if she be destined for Oporto, and a vendaval, with dismal, blowing weather, prevails, it would not be prudent to close with the coast, for being very rocky near it, and the heights of the interior difficult to make out, a vessel will be at a loss to make sure that she is on the parallel on which she can approach the Douro.

From the coast of Galicia with a vendaval.

Should the vessel be bound to Vigo or any other estuary, she may stand along the coast between the mouth of the Mino and Cape Silliéro, taking care with such weather not to overrun her distance, for the currents will set the vessel to the northward, and how much, it will be difficult to determine. Having made the Cies Islets, which are high and remarkable, she may take Vigo Inlet, or continue for her port if it be north of them.

Vessels bound to Corunna or Ferrol in a vendaval must also take care not to overrun their distance, for they will find a difficulty in recovering it to windward. When the S. W. wind is attended with very thick weather, the coast of Galicia is completely obscured, and it is necessary to see much of it to make it out. With such a destination she should make Capes Finistère, Tourinana, or Villano, and keeping the coast, run along it at a convenient distance, not to lose sight of it, for the port of destination. After doubling Cape Villano the wind will be more favorable.

If a vessel, considering herself off Cape Finistère, should find the coast so obscured that she cannot make sure of it, it will be most prudent to stand off and on, keeping sufficient sail on her to prevent falling to leeward, and wait till the weather clears so that she can make the coast satisfactorily. Cases are known when the breakers on the reefs have been close to a vessel from which the trend of the coast could not be seen, nor headlands nor lights by night. In such cases doubt must prevail, and the best plan is always to stand off and wait for clearer weather.

From north to south on the coasts of Galicia and Portugal.

The reverse navigation, that is, from north to south, may be made with the utmost freedom from anxiety; because, being the season of the northers, a vessel has but to run along the coast. But it is not so in winter-time and with the vendaval, for she has then a head-wind, dirty weather, a heavy sea, and contrary current. On the coast of Galicia she may have recourse to any one of its open and safe estuaries; but on that of Portugal she can only reckon on a very few ports, and all of them with bars.

A vessel running from north to south on these coasts, with a fresh N. W. wind, must be very careful of her course. With this wind, which is on shore, she must take care to keep to the westward of the course required by the line of coast, for the vessel will be drifted toward the shore. Fortunately, those N. W. winds are not so much attended with dirty weather as those from S. W.; and although they bring heavy showers with much wind, these are always followed by clear intervals, which allow of the coast being seen, and the vessel may recognize her position from time to time.

From south to north on the coast of Portugal and Galicia.

The most troublesome navigation on the coasts of Portugal and Galicia is that from south to north, in the season of the northeasters, and these generally prevail with but slight interruptions all the summer, and especially in those years which navigators have called the *years of northers*. Even in the passage from Cape St. Vincent to the estuary of Ferrol, there are many instances in which vessels have been from one to two months making it.

When northerly winds prevail, which vary between N. N. E. and N. N. W., the navigator in an ordinary bad-sailing, square-rigged vessel has a trying task of it. Powerful vessels at once stand off the coast a long distance so as to avoid the strength of the current, which is always

heaviest in-shore, and succeed in getting a slant of wind from N. W., with which they make very fairly to the north-east: but small craft and coasters find themselves obliged to consume their provisions under the lee of some cape or point, avoiding the regular ports, so as not to increase their expenses by duties.

Should the vessel which is making her passage under such circumstances be fast, and her commander acquainted with the coast, he can profit by these unfavorable conditions. To effect this, he will avail himself of every slight alteration in the wind, taking care to be near the coast at nightfall when it comes from the N. E., and stand out at daylight so as to tack in-shore about noon and again get hold of the coast. If with this he can manage to combine the favorable set of the tide, he will forward his voyage far better than those navigators who, from fear of the shore, keep it at a great distance without profiting by the changes favorable to them, either in-shore or out on the offing.

When the northerly winds bring much sea the voyage is necessarily delayed, for this completes a combination of opposing conditions for the navigator, and obliges him to remain for days, and perhaps weeks, under the shelter of Cape St. Vincent, at Setuval, Cascaes, Peniche, &c., and it is seldom that the coasting craft escape without having recourse to all those anchorages.

Steamers make their passages along the coast either way. They keep off the coast to seaward, but, making it for the sake of their position, always pass inside the Berlings, either by day or night, unless, indeed, the weather is so obscure that they have no chance of seeing them.

Landfalls, Str't of Gibraltar.

For vessels coming from the Atlantic, the points for making the land are Cape Spartel on the African, and Cape Trafalgar on the Spanish coast. On the former there is a fixed light, on the latter a revolving light, visible, respectively, twenty and nineteen miles. Around Cape Spartel the land is high, free from dangers, and generally steep, too. Trafalgar, on the contrary, though with equally high land back of it, terminates in a low peninsula, difficult to distinguish when it lays against the higher lands. It is also surrounded by banks, which are extremely dangerous, and extend to a considerable distance off shore. Large vessels should not approach them without taking every precaution. It results that, unless the weather be very favorable, the

best point to make is Cape Spartel, or rather the mountains which command it.

Owing to the current observed by Major Rennel, which was verified by the observations on board the *Phare*, setting from E. to S. E., toward the entrance of the strait and toward the coast of Africa, it would be prudent, when navigating within the limits ascribed to it, before mentioned, should no observations have been obtained, to add at least ten miles to the easting of each day.

Making the land at Cape Trafalgar has its advantages if the winds are from N. W. to N. E., and even from E. In this case, when coming from the N., a vessel should keep the coast of Spain aboard, and especially if the wind is strong; but with winds from S., S. W., or S. E., it is preferable to make Cape Spartel.

In making Spartel there is no other danger than that of getting to the southward of the strait and on the west coast of Africa, which is generally low, and only seen at a short distance. To the southward of the high mountains which form Cape Spartel is a deep valley, with low land along the coast. Seen from a distance, before the land along the coast is made, this valley has the appearance of a large channel; so much so, that many have run on the coast supposing that they were entering the strait. During the night, or in foggy weather, every precaution should be taken, and with bad weather, and with winds from S. to W., it is prudent to heave to, or to make short tacks if the light on Spartel has not been seen.

The coast of Spain, although more dangerous than that of Africa, presents, particularly to the southwest of Cape Trafalgar, a large plateau of soundings, which might be of great service in making the land. This plateau, on which are found off shore some ridges, (the bank of Phare,) having less depth than in its center, and even less than near the coast, would be insufficient to establish the position of a vessel, were not the precaution taken in sounding to ascertain the edges of the bank; but as long as the soundings are more than twenty-seven fathoms there is a certainty of being outside of all danger.

With soundings less than twenty-seven fathoms, the inspection of the chart will be sufficient to guide the navigator. If no point has been sighted on the coast of Spain, he will see that near Cape Trafalgar the soundings below

twenty-seven fathoms are sufficiently near the dangerous banks lying off the coast to make it prudent to keep off shore.

Traversing the strait from west to east.

In passing through the strait from west to east, with a favorable wind, whether with a steamer or a sailing vessel, it is generally preferable to keep toward the middle of the strait, as here the current to the eastward is the strongest; however, if the tide is favorable, a direct course may be made without any inconvenience, following the coast of Spain or Africa at a suitable distance, according as the land was made to the north or to the south.

Passing the strait with a head-wind a steamer should make a direct course; if in the middle of the strait the easterly current is stronger than it is upon its borders; the winds are also much fresher; thence, the tide being favorable, it will be most generally advantageous to follow the coast when the winds are strong from the E., and if these winds are very violent a steamer should keep the coast close on board.

Sailing vessels wishing to pass through from the westward, with the wind at E., should work to windward in the middle of the strait; should the tide be favorable they can stand on to near the land to take advantage of the variation of the wind which generally takes place near the coast, but if the tide is unfavorable they should avoid coming within its influence along the shore.

If the wind becomes too fresh it should be recollected that often the winds, which are very fresh in the middle of the strait, lose their force as the shore is approached, when, if the tide is favorable, a sailing ship should try to work to the eastward on the edges of the strait; but when it ceases to be favorable, to prevent their being driven back to the ocean, it would be necessary to seek a protection on the coast to await at anchor the slacking of the tide. Generally, merchant vessels arriving from the westward, when they meet head-winds from the E. sufficiently strong to prevent their working through the strait, seek shelter to the southward of Cape Spartel, off the coast of Jeremias. Most frequently they make short tacks there, awaiting the N. W. wind; this should only be adopted when unable to enter the strait or to reach an anchorage. If already in the strait, there should be no hesitation in gaining the nearest anchorage. The coast of Spain, between Tarifa and Cape

Trafalgar, offers numerous shelters from an easterly wind; a vessel can anchor according to circumstances, at Cape Plata, abreast Los Lances and even in the bight of Bolonia or of Val de Vaqueros; but should the wind haul to the southward no shelter is to be found on the coast of Spain.

On the African coast the anchorages are less safe in easterly winds; however, besides the Bay of Tangier, which affords security with every wind except from N. E. to N. W., and where only a N. W. wind need be apprehended, a vessel might anchor to the westward of Point Cires, in the bight of R'Mel at Cala Grande; but should the wind come from N. there would be no shelter on the African coast.

If anchoring in the strait, a vessel should be ready to take advantage of the tide to continue her route if the wind becomes sufficiently moderate. It is rarely the case, and only under the most favorable circumstances, that a vessel can clear the strait in one tide; accordingly by seeking a shelter from the E. winds at Cape Spartel a vessel cannot hope to pass the strait until the wind changes, whereas by taking an intermediate anchorage to await the slacking of the head-tide, it is nearly certain, if the winds moderate, that the strait will be quickly cleared.

As far as the currents are concerned, it would not appear to be any more advantageous to work to windward on the Spanish than on the African coast.

It is shown by the trends of the land, that a vessel will be better sheltered on the coast of Spain, principally between Tarifa and Trafalgar. If the winds are violent, and especially if they are to the N. of E., it will be preferable to keep near the land on the coast of Europe; the sea will not be so heavy and the wind more moderate; the same would hold good for the coast of Africa were the wind to the southward of E.

Landfalls coming from the east.

When coming from the Mediterranean, the points for making the land are the Rock of Gibraltar on the Spanish, and Apes Hill on the African coast.

If the weather is clear the Rock of Gibraltar and Apes Hill can be seen at a great distance; they appear generally like islands and from their forms are readily recognized. The Rock of Gibraltar presents at its summit a ridge of considerable extent, inclining slightly from north to south. The northern portion, which is the most elevated, is rounded; the O'Hara Tower overlooks the southern part. At the

center of the ridge is a small pinnacle on which is situated the signal tower. Half way up the rock, on its eastern face is a large, white spot. Apes Hill presents two conic summits close together, the northernmost of which is the highest.

The coasts of Europe and Africa, in making the land of the strait from the Mediterranean, are equally clear of dangers. Most generally vessels entering the strait follow the coast of Spain, in which case the Rock of Gibraltar is made. At a certain distance the rock is sometimes confounded with the high land which surrounds the Bay of Algeciras, terminating at Point Frayle.

Making the land at night or with thick weather, on the coast of Spain, requires much caution. The Rock of Gibraltar being connected with the continent by extremely low land, which terminates to the N. at the foot of Mount Carbonera, from the configuration of the coast, many vessels, believing themselves to be in the strait, run on the shore of Malbaye. It is always prudent, if not certain of the position, to reduce the speed until the light on Europa Point is seen. The soundings also can be utilized in making the Rock of Gibraltar. On the parallel of Europa Point, at the mouth of the strait, the water is very deep, while to eastward of the rock, and especially opposite the shore of Malbaye, the depths decrease toward the shore, regularly but rapidly. If, then, the bottom is obtained, it is certain that the vessel is not at the entrance of the strait. Besides, the depth of water will give the approximate distance from the coast. In no case, during thick weather or at night, should a vessel run to the westward without having plainly made out the light on Europa Point.

The peninsula of Ceuta, although less elevated than that of Gibraltar, is connected with the continent by tolerably high land on which is situated the town of Ceuta. Vessels running for the strait along the coast of Africa have less to fear from errors similar to those above mentioned, but caution is equally necessary with foggy weather or at night. The soundings will also give indications, and the route to the west should not be made until assured of the position by sighting the light on the eastern part of the peninsula.

Though at this entrance of the strait the currents generally run to the E., it should be observed that they sometimes incline to the N. E. or to the N. W. if the wind has blown strong for any length of time from S. W. to S. E., and

they incline also toward the S. E. or S. W., as the wind is from N. W. or N. E. In making the land these irregular currents should be taken into the account. Should the wind be violent it will be advantageous to run close along the coast which offers the most shelter.

Vessels coming from the Mediterranean, when they meet fresh head-winds, seek shelter in Malbaye Bay, and, when they can do so, in the Bay of Gibraltar. This is in fact the only anchorage to take if the strait is to be passed with head-winds. If it is necessary to await an E. wind there are also shelters on the coast to the south of Ceuta, better protected than that of Gibraltar against westerly winds; but the bay north of Ceuta is exposed to winds from the N. E. and N. W., and comparatively few resources are found there. All anchorages in the Mediterranean, whether on the coast of Africa or Spain, which are exposed to the E. wind, should be abandoned as soon as the wind has a tendency to that direction, for the moment it becomes strong it may be impossible to double the points.

Traversing the strait from east to west.

In passing through the strait from E. to W., with a favorable wind, whether under sail or with steam, it is always advantageous to keep near to one of the shores, to take advantage of the current to the W., if the tide is favorable; and of the weaker current to the E., as also the counter-current, if there is a head-tide. It is well to recollect that near the most salient points of the strait the current to the E. is generally strong, and makes in close to the shore; consequently, these points are very difficult to pass when the wind is not fresh. They are, on the African coast, Points Leona, Cires, and Malabata; on the Spanish coast, Arcebuche and, especially, Tarifa. Thence, if the wind is fresh, or sufficiently so to stem the current, either coast may be taken indifferently; but should the wind be too light to pass these points, to prevent being drifted back by the current, it would be necessary to anchor and await the favorable tide. On the African coast, between Ceuta and Point Cires, there is no anchorage unless in very deep water, and within reach of a Moorish gun, while along the extent of the Spanish coast an anchor can be dropped to await the slack water without inconvenience; it is therefore preferable, with light and variable winds, to take the Spanish coast.

In passing the strait with westerly winds there is nearly

a certainty of meeting in its center the permanent current setting to the E., the velocity of which increases under the influence of the prevailing winds, especially if they have continued for a long time. Then a vessel cannot expect to clear the strait by working to windward, except by keeping on the edges of the strait, taking advantage of the favorable tides and counter-currents.

It would appear to be an exceptional case, where, with head-winds and a contrary tide, a sailing vessel succeeds in passing the salient points mentioned.

It has been already stated that near the advanced points the general current to the E. approaches very close to the shore, and that the belt where the alternate currents are found is very narrow; that, in the second place, the counter-currents resulting from the general current are particularly felt where the indentations in the coast are the deepest and most extended. From this it will be seen, by consulting the chart, what difficulties a sailing vessel has to contend with in working to windward between Ceuta and Point Cires. The shoals to the westward of Tarifa render the approach of this part of the coast equally difficult and dangerous. The following rule for traversing the strait with a head-wind, as advised by the pilots, appears to be the most sure, though with the best charts, in certain cases, and particularly with the winds from W. to N., it may be advantageous to remain on the coast of Spain, even when to the west of Tarifa:

General rule for working through the strait.

To traverse the strait, as a general rule, the coast of Spain should be followed from Gibraltar to Tarifa. At Tarifa a vessel should anchor if the tide is unfavorable. If favorable, and the Point of Tarifa cannot be doubled, cross the strait and seek the counter-currents to the west of Point Cires, and continue working to the westward, keeping as near as possible to the African coast. According to this rule, a vessel in making the land should run always for the Rock of Gibraltar. If the winds from the westward are light or variable a vessel would be exposed to be drifted back in trying to double Europa Point with an unfavorable tide. It would, therefore, be preferable to await the commencement of the flood in the strait, under the rock in Malabaye. Then it will be necessary to work to windward as near as possible to Europa Point, and avoid long tacks to the S., to keep out of the rapid current to the E., and not to stand

into the Bay of Algeciras until sufficiently to windward to double easily Europa Point.

When the westerly wind is fresh and steady, a good sailing vessel, as an exceptional case, might expect, particularly with the neap tides, to pass Europa Point even with an unfavorable tide; but, during the springs, it is extremely seldom that the Bay of Gibraltar can be reached against the wind and currents.

If the land should be made on the Ceuta side, and it is desired to make the anchorage in the bay to the north of the peninsula, a vessel should maneuver in the same manner to pass the north point of this peninsula. Having doubled Europa Point, it will be easy for a vessel to hold her own during the ebb, and perhaps even make to the westward, by tacking while the ebb lasts within the line of the outer currents; that is, without passing to the south of the parallel of Europa Point; but it is always necessary to await the commencement of the flood to pass Acebuche Point. Once past this point, one favorable tide is generally sufficient to reach Tarifa, by working near the land. Consequently, a vessel under sail, leaving the Bay of Algeciras, should get underway on the half ebb, arriving at Acebuche Point about the beginning of the flood, and probably at Tarifa before the end of the tide. Then anchor at Tarifa, or at the point reached at the end of the tide, and await the slacking of the ebb. With the following flood tide, try to double Tarifa Point; if not successful, cross the strait for the coast of Africa to the west of Point Cires, when, work to the westward, taking advantage of the counter-currents which exist along this part of the coast, until the return of flood permits Malabata Point, with its surrounding shoals, to be doubled, and the Bay of Tangier reached.

The route across the strait, on leaving Tarifa, should not be taken, unless certain of fetching to the westward of Point Cires on the coast of Africa. To accomplish this, it will be almost always necessary to await the flood tide, and it should not be attempted until up with the Peninsula of Tarifa, and the wind should be steady. In case of fetching to leeward of Point Cires, a vessel will be almost certain of being driven back by the current, without even a certainty of being able to gain the Bay of Gibraltar. It is then necessary, as soon as it is ascertained that the vessel is driven back, to stand toward the coast of Spain sufficiently to windward of the

Bay of Gibraltar to prevent missing it. If, arriving at Tarifa with a favorable current, the attempt should be made to double this point by tacking near the shore, then it will be preferable to work to the westward as long as the current is favorable, by keeping in the Bay of Los Lances, outside the central current, and an anchorage can be made there to await the fair tide. If there is a fear of the Cabezos and the land, cross the strait as before directed toward the African coast, watching the most favorable opportunity.

This route is the one recommended with steady westerly winds, but it often happens that these winds vary from S. W. to N. W. after passing Tarifa Point; then it would be advantageous to remain on the coast of Spain. With the wind from N. W. the Cabezos can always be passed by making a long tack off shore, and if the wind is S. W. in crossing the strait, there would be danger of being drifted back. Under all circumstances it is not advisable for a vessel to leave the coast of Spain for the African coast, excepting to take advantage of the counter-currents between Point Cires and Al-Boassa, and when working to windward becomes difficult and dangerous in the vicinity of the Cabezos. As soon as to windward of this danger a vessel can work to windward on the coast of Spain as well as on that of Africa, and be able to lengthen the tacks as the easterly current becomes less and less strong in proportion to the distance from Tarifa. It will, however, be necessary to be in a position to anchor when the head-tide commences to be felt.

The African coast has, nevertheless, a great advantage over that of Spain in the counter-currents being better established, and spreading more from the coast between Points Cires and Al-Boassa; in being more sheltered from the S. W. winds and offering a good anchorage at Tangier, where a vessel can always await a favorable time for sailing.

The passage between the Cabezos and the Bajeta is very rarely used; the pilots of the locality even prefer to take the passage between the Bajeta and the coast. However, the channel between the Bajeta and the Cabezos, which was carefully examined by the *Phare*, is clear of dangers, and is sufficiently wide for a vessel to work in; but the tides are very strong, and most frequently the shoals do not show, even with a fresh wind. It would not be prudent to enter this channel without having well calculated the tide. On the coast of Spain there is no suitable anchorage; with

strong winds from W. and S. W., the Bays of Val de Vaqueros and Bolonia, which are the least exposed, offer no shelter.

The route just given, following the coast of Spain to Tarifa, then crossing the strait to the African coast, is that generally adopted. Its advantages are: the anchorage in the Bay of Algeciras, the counter-currents between Europa Point and Point Acebuche, and also between the latter and Tarifa. The coast of Africa, between the Peninsula of Ceuta and Point Cires, does not present the same advantages; however, with the ebb in the bay north of Ceuta, there is a counter-current, extending but a short distance from the shore, which ceases to the west of Point Leona. The alternate tidal currents exist also between Point Leona and Point Cires; but the space in which they are felt is very narrow.

Following the coast of Africa these movements of the waters may be taken advantage of in passing through the strait from E. to W. with head-winds. Taking Ceuta for the point of departure, it will be necessary to start at half-ebb to arrive at Point Leona at the commencement of the flood. If Point Leona is passed with the favorable current it may be expected to get sufficiently to the westward to double Point Cires on the same tide, when the vessel would fall into the conditions of the route before mentioned.

In general, vessels going from the Mediterranean to the ocean should be up with the land at Point Europa; but if, from any circumstance, they have fallen over on the coast of Africa with westerly winds, they should attempt to pass the strait on that side sooner than to run the risk of being drifted back, in gaining the European coast. The route along the African shore has, besides what has been already mentioned, the disadvantage of requiring much shorter tacks; but with winds from the W., and especially S. W., momentary shelter will be found in the little bays of Benzus, Almanza, and Cires, which the coast of Spain does not afford.

It is evident that the navigation of the strait from E. to W., with head-winds, consists in taking advantage of the alternate currents of the tides near the shores: these currents vary considerably in strength, not only with the direction and intensity of the winds, but also with the age of the moon. It would seem that at the spring tides, if the westerly winds are sufficiently moderate for the working of

a vessel, the strait can generally be passed, while, on the neaps, most frequently a large vessel will be obliged to abandon it. The route along the coast of Africa appears particularly difficult, and between Ceuta and Cires almost impossible, when the currents of the tides are weak. We repeat the opinion that, under favorable circumstances, a vessel starting from Ceuta should not cross the strait for the coast of Spain until after having tried to pass Point Cires. This is even necessary, for on leaving the African coast the strait will be traversed to close with that of Spain, under the most advantageous circumstances, by leaving a point to windward of Point Cires.

Having arrived at the meridian of the bay of Tangier, the passage of the strait is nearly assured. Generally the winds are there found more moderate and the easterly current less rapid than in the eastern part of the strait, and then the tacks can be lengthened at pleasure. However, with a favorable tide, when on both shores the westerly current is felt for a considerable distance off the land, it is better to keep to the coast. In all cases if the wind freshens and threatens to become violent, and there is reason to believe that the vessel will not be able to make to windward, the anchorage of Tangier should be gained, where the position is good for profiting by a change of weather. Having passed Cape Spartel, if the wind is S. W., the port tack should be taken; if W., the tack to the northward; and if N. W., that to the southward, and that without reference to the tide. If going to the S., a vessel should continue to get to windward to give the African coast a good berth, and an allowance should be made for the current. If standing to the N. the tidal currents may be utilized, if favorable, by approaching the coast of Spain; but, if unfavorable, keep fifteen or sixteen miles from the land.

CHAPTER IV.

ANCHORAGES AND DANGERS.

As the port of Cadiz is much frequented and is the only one on the coast which offers a safe refuge against the S. W. gales to vessels in its vicincity, we will give the directions for entering the harbor, and also a description of the anchorages within the Strait of Gibraltar.

Cadiz.

The banks at the entrance to Cadiz form two principal channels; the one, the Northern or Grand Passage, the other, the Southern or Little Passage. These are the only practicable channels for vessels of any size. The Northern Passage is the largest and deepest; the Southern has the advantage of being the most direct; there is, however, sufficient room for a vessel to work in either. Small vessels only should enter the narrow passage which separates the Galera from the Diamante Bank. The first is distinguished by an iron buoy painted red, with a mast, anchored on its western edge, in five and one-fourth fathoms, and west-southwest from the Chateau of Santa Catalina.

The directions generally given for entering the harbor of Cadiz, between the Puercos and the Diamante, are to bring in line the steeples of Medina and Puerto Real, bearing about S. 70° E. true,* and keep them so until the gates of St. Domingo are open off the low Point of Phillip, on the extremity of which is a flag-staff and saluting battery; or the small mole called the mole of the Seville gate is open off the point, when the lead will be a sufficient guide to the anchorage. These directions are excellent, but frequently the points mentioned cannot be distinguished, either owing to the mist, or from being hidden by the vessels anchored in the harbor. The bearings for entering the harbor of Cadiz, as adopted by the *Phare*, were as follows:

Northern Passage.

Coming from the north, after making Rota and San Sebastian, bring San Sebastian to bear S. 56° E., and steer for it until the fort on Santa Catalina (on the north shore of the bay) bears E.; then, if the Northern Passage, is to be taken, steer for this fort, leaving the Rota Reefs to the

* The bearings given are true, unless otherwise mentioned.

northward, and the Galera Bank to the southward, and when the two steeples of San José bear S., the vessel will be to the eastward of the Galera Bank, when, by steering for them, the anchorage will be reached.

Southern Passage.

If the Southern Passage is to be taken, (as before,) bring San Sebastian to bear S. 56° E., and steer for it until the fort of Santa Catalina is open to the southward, or to the right of the steeple of Santa Maria; if the steeple should not be seen, bring the fort to bear N. 58° E., when run on this bearing, leaving to starboard the Olla and the Cochinos, the Puercas will soon be seen; as soon as they are made steer east to pass three or four cables' lengths to the northward of them, when steer for the anchorage. The Puercas are uncovered at low water, and always break when the tide is high.

The Olla and Cochinos usually break; the latter, which are partly uncovered on spring tides, are marked by a bell boat, painted red, anchored in six and one-half fathoms of water, on the west edge of the bank, and S. 50° E. of the castle of Santa Catalina. The Puercas are nearly always visible, and mark well the southern shore of the channel. It is necessary to avoid passing too far from them, as the Diamante to the northward of the channel does not break except in rough weather. If, which is seldom the case, neither of those dangers show, then steer on the bearing, the fort of Santa Catalina open to the S., or to the right of the steeples of Santa Maria, that is N. 58° E., until the light-house of San Sebastian bears S. 10° W., then steer to the east for the anchorage. At the entrance of Cadiz, with the ebb tide, the currents set strong across the channels which separate the Puercas, the Cochinos, the Frayle, &c. With the flood, on the contrary, the current sets toward the Diamante, especially on approaching the bank.

From the southward.

When seeking the entrance to Cadiz from the southward, it is necessary to give a good berth to the rocks off the Point of San Sebastian, and to double it at the distance of a mile, particularly on the flood, when the current sets toward the land. Bring the town of Rota north until the fort of Santa Catalina is open to the S., or to the right of the steeple of Santa Maria, that is, until the fort bears N. 58° E.; then, if the Southern Passage is to be taken, follow the directions already given to reach the anchorage. But, to take the Northern Passage, continue to run north for Rota

until Fort Santa Catalina bears E., when follow the directions already given for the Northern Passage.

In beating in between Galera Shoal and Santa Catalina, do not open any part of Marrucco Hill, north or south of Puerto Real. Beating.

Beating between the Diamante and the Puercas, the former should not be approached nearer than to bring the south end of Medina on with the north end of Puerto Real, and in standing to the southward the north end of Medina should not be brought to the southward of the south end of Puerto Real.

A vessel should not attempt to enter Cadiz at night or in thick weather, unless the land can be seen distinctly at a distance of at least two miles, and then only when the circumstances justify the risk run. The soundings cannot serve as a guide, and the lights on San Sebastian and Rota are insufficient. Should the sea break on the Cochinos and the Puercas, they would serve as a guide, if seen; but the passage to the northward is the most sure of the two, and if necessary to enter at night the following route might be taken: Bring Rota light to bear N. and steer for it until the light on San Sebastian bears S. 29° 45′ E., when the point of the shoal south of Rota would be about one and two-thirds miles distant; steer then N. 82° 35′ E., between the reefs of Rota and Galera, keeping a lookout for the buoys marking the southern point of the one and the northwestern extremity of the other; when San Sebastian light bears S. 13° 35′ W., and Rota N. 58° 25′ W., steer in on the latter bearing, not decreasing the soundings to less than five fathoms, and as Santa Catalina is approached keep gradually to the southward and steer for the anchorage. By night.

The Road of Cadiz, where vessels generally anchor, in front of the city, is but partially protected, and anchorage for large vessels is far from the city and of small extent. The best anchorage is the Road of Puntales, where the water is deep and the holding ground good. It is, however, very narrow; and as a passage has to be left for vessels to and from the arsenal, it is not frequented excepting by vessels under repair. Cadiz.

In mooring in the roadsteads of Cadiz and Puntales, the anchors are laid east and west, in the direction of the tides.

From sunrise to sunset pilots are obtained inside of five miles from San Sebastian light. Though the entrance to Pilots.

Cadiz offers no difficulty by day with a fair wind, it is not so if necessary to beat, when it is advisable to wait for a pilot.

Bay of Barbate. The Bay of Barbate, between Cape Trafalgar and Cape Plata, affords an anchorage for vessels, with winds from N. W. to N. E. and E. With those from N. W. to N. E. it is preferable to anchor to the south of the River Barbate, but the coast should not be approached too near, as in the vicinity of the Tower of Sara there is a bank of rocks on which there is but three and three-quarters to four and a quarter fathoms of water. With strong winds from the E., the best anchorage is to the west of the Tower of Plata and very near the land, owing to the better quality of the bottom and the shelter afforded by the Sierra Plata. The sea is smooth, but a fresh levanter blows in violent gusts from the mountains.

Though it is extremely useful to know these anchorages, where a vessel overtaken by a violent wind from the E. can find shelter to await its moderating or a favorable tide, it must be borne in mind that these anchorages become very dangerous with winds from any other quarters than those mentioned, and that a vessel should leave immediately on the levanter subsiding.

The Bay of Bolonia. The Bay of Bolonia, which is about three-quarters of a mile deep, having a sandy beach, and at its head a coast guard station, with the ruins of the ancient town of Belon, affords a shelter with winds from N. W. to N. E. The bottom is sand in the middle of a plateau of rocks. The five-fathom line extends further from the shore at the opening of this bay than elsewhere.

Anchorages off Tarifa. Off the shore of Los Lances, to the westward of Tarifa, there is a very good shelter from easterly winds. The gusts are heavy, but the holding ground is good and the sea smooth. The anchorage to the eastward of Tarifa is imperfectly protected from W. winds and very much exposed with those from S. W. The water is deep and the holding ground not good, and sailing vessels should only take advantage of this anchorage to await a favorable tide.

Pearl Rock. A dangerous rocky shoal, called the Pearl, somewhat more than a half mile to the south of Palomas Island, lies in the way of vessels bound into Gibraltar Bay. It lies with San Roque Church in line with the inner part of Cabrita Island; the second little peak from Carnero Point in line with Pal-

mos Island and Gualmesi Tower, or with the outer rock of Acebuche Point. Like all the banks of the strait it is formed of pinnacle rocks, having thirteen feet of water on it, with intervals of deeper water. The passage between it and Palomas Island varies from five to ten fathoms. This channel offers some advantages on account of the eddies of the tidal current, but it should not be attempted except by small vessels and with a favorable wind. Should the wind there not be well established, sudden shifts and gusts may be expected, occasioned by the proximity of the high lands.

The best range for passing between this rock and Palo mas Island is the light-house of Tarifa, in line with the outer rocks of Frayle Point, with the Gualmesi Tower shut in by Point Acebuche.

Passing outside of Pearl Rock, keep the Tower of Gualmesi well open of the rocks of Acebuche Point until San Roque Church is open off Cabrita Rock.

By night keep to the southward of the strip of *red* light extending half of a mile to the southward of the position of Pearl Rock, shown by the light on Europa Point, and open Europa Point white light until Verde Island light is seen, when steer into the bay. A vessel from the eastward, while Europa red light is seen, should not shut in Verde Island light until Tarifa light bears northward of S. 73° W., when it may be steered for.

Bay of Gibraltar.

Within the Bay of Gibraltar, limited by the Peninsula of Gibraltar on the east, and by Point Carnero to the west, are the best anchorages of the strait.

Bay of Getares.

From its position at the entrance of the Bay of Gibraltar, the Bay of Getares is one of the most favorable anchorages for vessels awaiting easterly winds to pass the strait. The holding ground is good, and the shelter from W. winds excellent, though with these winds the gusts are very strong. The dangers are very near the shore, and a vessel can anchor in the middle of the bay in eight to twelve fathoms. The bay is exposed to N. E. and S. E. winds, which send in a heavy sea. Vessels should, therefore, leave as soon as there is any sign of a levanter.

Algeciras.

The anchorage at Algeciras is also very good and secure with westerly winds, and the holding ground is excellent. The best anchorage for large vessels is on the parallel of Fort San Antonio, with the light tower on Verde Island S. 26° W. Smaller vessels would have a good anchorage in

nine fathoms water, with Verde Island on with San Garcia Tower. About four cables northward of Verde Island is an isolated conical rock, with about two and a half fathoms of water on it. The Galera Rocks, one cable distant from the mole, cover and uncover with the tide, and can most generally be seen. To the northeast of these is a shoal of the same name, having nine feet of water. From Point Carnero to Verde Island the shore can be approached to the distance of a half mile in from ten to sixteen fathoms of water.

To the north-northeast from Fort San Antonio is the Tower of Almirante, which is round, white and conspicuous. From the rocks at the foot of this tower a reef extends off, and at four cables from the tower there is three and three-quarter fathoms. Three-quarters of a mile inland from this tower, and on the slope of another hill, is a square tower in ruins, surrounded by a wall. With these towers in line and near the shore the bottom is rock and gravel. A vessel should avoid anchoring with those marks on, or in that vicinity.

Palmones.

To the northward of the tower of Almirante is a plateau of rocks, the largest of which are generally uncovered. Here a long sandy beach commences, which extends as far as the Tower of Rocadillo. A vessel can anchor off this beach, opposite the entrance of the River Palmones, but the coast should not be too closely approached on account of the sand bank which extends some distance from its mouth. This anchorage, though inferior to the former, appears to have been much more frequented when the river was accessible to vessels of greater tonnage than it is at present. As the anchorages at Algeciras and Getares, it is well sheltered from westerly winds; but with easterly winds the sea is very heavy, and with strong winds from S. E. dangerous. When this wind commences, a vessel should shift her berth to the other side of the strait.

Gibraltar.

The plateau of least soundings on the Gibraltar side of the bay commences at Mayorca, and extends to opposite the New Mole, at the central part of the rock; its outer edge is very steep. Near Point Mala, and in the bight between it and the tower, there is but little water, which makes the anchorage for large vessels very limited. The best anchorage is abreast the neutral ground—the low peninsula which connects the rock with the continent—as here, during strong easterly winds, the breeze is steady, while under the rock a

vessel is kept constantly swinging and surging on her chain by the heavy squalls and eddies blowing down the rock. In anchoring off the neutral ground it is necessary to have the Devil's Tower, which stands at the foot of the northeast end of the rock, open of the rock. With the church of San Roque nearly in line with Mala Point, and the Devil's Tower a little open, there will be from fifteen to eighteen fathoms of water and good holding ground.

Men-of-war most generally anchor under the rock between the Ragged Staff and the New Mole, in from fifteen to twenty fathoms water, but, as before mentioned, this anchorage is objectionable, owing to the heavy gusts which blow down the rock with strong easterly winds. Between the Old Mole and the Ragged Staff, the bottom is uneven and rocky, though there is very good summer anchorage off Jumper's Bastion in nine to thirteen fathoms water; bottom sand.

Winds from the S. W., blowing directly into the bay, send in an uncomfortable sea; during the winter, on the approach of these blows, vessels should either leave this anchorage for that of Palmones, or immediately let go another anchor, and make everything snug. It is probably owing to the want of proper precaution that so many wrecks have been piled up on the neutral ground.

Directions for entering the Bay of Gibraltar from the westward.

Vessels coming from the westward with a fair wind, wishing to anchor at Gibraltar, whatever may be the tide, should give a good berth to Pearl Rock and Carnero Point, recollecting that the current in the vicinity of the latter has a tendency toward the shore, and that the gusts are at times very strong over this point; often, even when the winds are blowing fresh in the strait, they shift suddenly to N. W. on opening the bay. If it is necessary to work up the bay, keep as much as possible within the line of the favorable currents.

With easterly winds.

Coming from the westward with easterly winds, it will be better not to steer for the anchorage until the middle of the bay can be made on the starboard tack, when keep in the steady wind to westward of the strong gusts and eddies which come down the rock, and work up for the anchorage.

However, should the wind be very strong from the E., making it necessary to enter the bay for a smoother sea, a vessel should, particularly with the flood, pass well to windward of Point Carnero. It often happens, with fresh easterly winds, that a vessel cannot work up the bay, owing to

the heavy gusts from the rock, together with the baffling winds in the intervals between them. Under these circumstances it is preferable to enter the bay close to Europa Point, and follow the rock to gain the anchorage. A vessel entering the Bay of Gibraltar with strong easterly winds should be under manageable sail and ready to brace to the eddy winds at any moment.

From the eastward.

When coming from the eastward with a fair wind, a vessel should pass close to Europa Point, and maneuver as above directed.

If the wind is from the W., or the breeze favorable but not strong enough to stem the ebb tide, it will be necessary to await the flood to enter the bay. In the first case an anchorage can be taken at Malbaye. With unsteady winds from the eastward it is better to keep under way. The best anchorage in Malbaye is on the parallel of the neutral ground, where the holding ground is quite good, and protected from W. winds. The anchorage should not be left until the commencement of the flood, and then, at Europa Point, near the land, the current will be found running to the W. S. W. With the wind from the westward, the Rock of Gibraltar should be passed at a good distance in entering the bay, to avoid the calms produced by the reflection of the W. winds against the high land. At night, if the anchorage is not well known, it is prudent to anchor outside the vessels, in from sixteen to twenty-two fathoms of water. The red light on the New Mole will assist a vessel in anchoring.

The anchorage at Algeciras is much easier taken than that at Gibraltar; the plateau of small soundings extends further from the shore and the lead is a good guide.

By night, if the green light on the Isle Verde is seen, steer to pass a good distance to east of it, and when the light on Europa Point bears S. 65° E., steer N. 65° W., then a little to the northward of the lights in the town and sound to an anchorage.

Anchorages on the African coast, Jeremias Bay.

The anchorage of Jeremias Bay, about two and a half miles to the southward of Cape Spartel, is frequented by vessels prevented from entering the strait, by strong easterly winds; at a mile from the shore there is twenty fathoms of water, with a clean sandy bottom and good holding ground.

Indios Bay.

Indios Bay does not offer any shelter and the landing there is difficult, its eastern point is surmounted by a fort in ruins; near and to the eastward of this fort commences a

white or grayish clift which inclines rapidly toward the sea and terminates at Tangier Point, distant one mile; seen at a distance it has the appearance of a white patch in the middle of the coast. The shore is here skirted by reefs, and Tangier Point terminates in a bed of rocks.

Tangier Bay.

The Bay of Tangier, Malabata Point forming its eastern and Tangier Point its western extremity, is three miles wide and one deep; from the offing it appears much deeper, owing to the high land by which it is surrounded; it has a fine sand beach, beyond which in the interior are some hills, and among them Mount Direction can be easily distinguished from its conical form, and from its being isolated; a little to the east of Mount Direction is a less elevated plateau; on its summit to the S. W. is a white marabout, and to the N. E. some ruins. These two heights are separated by a valley, through which runs a small stream crossed by two bridges, the most distant is white, the other is in ruins and near the sea, and is readily seen from the offing. The eastern shore of the Bay of Tangier, with the exception of a small sand beach, is bordered by rocks, which extend about a cable's length from the shore, and some of them are uncovered at low water. On the eastern side of the bay are two batteries, one at the termination of the sandy shore, close to which is a tower in ruins. On the summit of Malabata Point is a battery and a round white tower which can be seen at a long distance, and is one of the best points to recognize on this part of the strait.

In the town of Tangier the most remarkable objects, from their elevation, are the fortress, which is the most elevated point, a square tower and a mosque. From the offing the bay of Tangier is always easily distinguished, by day or by night, by the sloping of the land. By day the tower of Malabata or the town of Tangier can be distinguished readily; by night, when it is not cloudy, the high lands forming the entrance to the bay are also readily distinguished, and even Mount Direction, which appears isolated between these points.

In front of the town is a reef, which appears to be a prolongation of the rocks, on which is a fort commanding the road; this reef runs east and west, is partly uncovered at low water, and extends a considerable distance from the shore; in its vicinity the soundings are very irregular.

Landing is only permitted at the custom-house, which is on the beach, and the gates of the town are closed at sunset.

Bourée Rock. The only danger in Tangier Bay is Bourée Rock, on which the least water is three feet, it is about one cable in extent, and the sea never breaks on it.

Anchorage. A vessel may anchor anywhere in the middle of Tangier Bay, in about seven and a half fathoms of water, bottom sand and good holding ground. The best route to gain the anchorage is by bringing Mount Direction to bear S (S. 20° W. by compass) and steer in on that bearing, when the soundings will indicate a suitable anchorage. In all cases the soundings will be about seven and a half fathoms, when Point Indios is nearly shut in by the point to the eastward of it, on which there is a ruined fort. Should it be necessary to work to windward, the Rock of Gibraltar on with Malabata Point will indicate the line, to the eastward of which a vessel should not pass, to avoid Bourée Rock.

The Almirante. Nearly six cables from Malabata Point, and N. 25° W. (N. ½ W. by compass) from the tower is a rocky shoal with three and a quarter to five fathoms of water on it, called the Almirante; with strong winds, particularly from the westward, the sea breaks on it. To the eastward of Malabata Point the shoal water runs out for some distance, and though between this and Almirante there is a channel with nine fathoms of water, it is more prudent for vessels, especially large ones, to keep outside of the Almirante.

Peril Rocks. Between Points Malabata and Altares there is a group of dark rocks detached from the shore, called the Peril Rocks, a part of them are always above water; to the north of these is a sunken rock, on which the sea sometimes breaks.

Caña Coja Reef. Between Points Altares and Al-Boassa there are several beaches of white sand separated by rocky points; the most remarkable of which is called Kankousch Point, it separates the two largest beaches, known as the Cala-Baja and Las Plaitas-Hermosas. Point Kankousch is prolonged by a reef, the greater part of which is dry at low water, it is called the Caña Coja reef.

Jaseur Bank. A third of a mile north-northeast of Caña-Coja Reef is the Jaseur Rock, with thirteen feet water on it. Inside of this there are other rocky heads with deep water between. The bank northward of it, with six and nine fathoms, extends one and one-half miles from the shore. The Phœnix Bank, with eight fathoms of water on it, lies N. ¾ W. from Point Al-

tares. To clear the Jaseur Rock, keep Tangier open of Malabata Point by a space equal to the apparent length of the town. The mountain of San Simonito on with Al-Boassa Point gives the direction of the Jaseur Rock. About two cables' lengths N. ¼ E. of Al-Boassa Point is a rock with three feet of water on it. There is anchorage on all the coast between Al-Boassa and Point Alcazar; the bottom is even and free from danger, but there is no shelter from E. or W. winds.

Point Alcazar to Point Cires.

The coast from Point Alcazar to Point Cires is free from dangers; it is generally bordered by clifts with rocks at their base, and sometimes a short sand beach. Point Cires is known by two rocky islets which extend from it. A vessel may anchor on this coast in from fifteen to eighteen fathoms of water, principally with the wind at E., to await the tide or until the winds moderate, which are often too strong in the middle of the strait to work to windward with advantage.

Cires Point to Ceuta.

From Cires Point to Ceuta the aspect of the land changes, with the exception of Cires Bay, the Bay of Almanza, and the Bay of Benzus, where there are sand beaches; the coast between Points Cires and Leona is bounded by steep clifts, generally inaccessible. A remarkable hill running north and south from Point Cires, and known as Mount Cires, in some positions resembles Gibraltar.

Almanza Bay.

At the bottom of Almanza Bay is a short sand beach; though of little extent, the anchorage in this bay is not so bad as the other anchorages on this part of the coast.

Island of Peregil.

The Island of Peregil is midway between Almanza and Leona Points. Although two hundred and forty-four feet high, it is with difficulty distinguished from the high land back of it; its western side is bold, with from eleven to twenty-two fathoms close to it. A reef extends off the northeast extremity of Peregil, and at a short distance a rock which is seldom uncovered at low water springs; at about two cables' lengths northeast of the island is a second rock with three and one-fourth fathoms of water on it. This rock is isolated with seventeen to twenty-two fathoms of water around it.

Bay of Benzus.

The depths in the Bay of Benzus are too great for anchorage; besides, with W. winds the gusts are extremely violent.

Benzus Shoal.

On Blanca Point, one and three-fourths miles to the

eastward of Leona Point, there is a ruined tower; to the northwest of this tower and four cables' lengths from the shore is the Benzus Shoal, with two and one-half fathoms water on it. Between it and the shore is covered with rocks which extend from the east shore of Benzus Bay. To clear Benzus Shoal, keep the whole of the walls of old Ceuta open with Bermeja Point, on which there are the ruins of a tower.

Ceuta Bay.

The Bay of Ceuta is limited by Point Bermeja to the west, and Point Catalina to the east. The shore of this bay is formed of sandy beaches, bounded by rocks at a short distance from the shore, the most conspicuous of which are those of Benites. The outermost, called the Campos, are two large rocks above water, about two cables northeast of Benites Point; these are surrounded by sunken rocks to the distance of nearly three-fourths of a cable; some are uncovered at low water, and the sea usually breaks. Shallow water extends nearly one-third of a mile from the shore.

Queen Isabella Bank.

Santa Catalina Point, the eastern extremity of the bay, is surrounded by rocks and reefs. The rocks off the point are high, and separated from the coast by a rocky channel. To the northwest of the Rocks of Santa Catalina, about one-fourth of a mile, is a bank of rocks called the Queen Isabella Bank, having on it three and one-fourth fathoms of water. The currents produce over it a considerable tide-race. With the exception of these dangers in the Bay of Ceuta, the soundings are regular, but increase rapidly toward the offing.

Port of Ceuta.

The Bay of Ceuta, properly called, is between Bermeja Point and the Rocks of Santa Catalina, but the anchorage is between the latter and the Campos Rocks. The modern town, or rather the district of Almina, occupies the northern and western slope of the Peninsula of Ceuta. The land east of the town of Ceuta is called the Almina; it is nearly two miles from east to west, and embraces seven small hills, on the summit of the largest of which, called Monte del Acho, is the castle of that name, six hundred and forty feet above the sea.

The best anchorage in Ceuta Bay is northwest of the middle of the new town, in from eight to thirteen fathoms of water; bottom sand and rock. In taking this anchorage the street of Obispo should be kept well open; it is easily recognized by the steeple of the convent of San Francisco, situated

at the upper extremity of this street, as also by the two small steeples a little to the westward of this steeple, which surmount the hospital of the town of Almina. This bay is protected from winds from S. E. by the S. to S. W., although when these winds are strong there is a heavy swell. It is open to winds from W. to E. by the N., and with W. winds the gusts are very violent. When these winds commence it is prudent to leave this anchorage for the anchorage south of Ceuta. In this case a vessel should be under way at half flood, in order to get out easily, and without being exposed to falling on the Santa Catalina Rocks; these rocks and the Isabella Shoal passed, a vessel may run near the peninsula, looking out for calms and squalls, as also for the tide-races, which are often very strong in this vicinity.

From Almena de Ceuta to Point Negro.

The coast between Almina de Ceuta and Cape Negro is generally formed of sand beach broken by rocky points. The only danger to avoid on this coast is the bank of rocks running out from Point Castillejos, on which there are from two to three and one-fourth fathoms.

South of Zorra Point, within one-fourth of a mile from the shore, is Viña Rock, a small islet about twenty feet high; it is detached from the coast and is readily seen.

Caballo Rock is a mile S. ½ E. of Point Castillejos; it covers and uncovers with the tides, but can be almost constantly seen. To the southward of the Cebello Rocks there are some ledges of rocks, but they are hardly separated from the shore.

Anchorage.

A vessel can anchor on any part of this coast, opposite the sand beaches being preferable to avoid the rocky bottom. Before anchoring the nature of the bottom should be ascertained; the holding ground is generally tolerable, and it is well sheltered with winds from N. W. to S. W., by the W., but, with winds from the eastern quarter it is entirely unprotected. With signs of easterly winds a vessel should therefore leave this anchorage and double the Peninsula of Ceuta as quickly as possible.

The anchorage south of the town of Ceuta is generally filled with fishermen's nets; moreover, the bottom is rocky, and a vessel may drag some distance before the anchor takes hold.

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